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THE LITTORAL ZONE BENTHIC MACROINVERTEBRATE COMMUNITIES OF 12 ACID-SENSITIVE HEADWATER LAKES IN SOUTH-CENTRAL ONTARIO: A SUMMARY OF THE FIRST FIVE YEARS

JULY 1997

Ontario

Ministry of
Environment
and Energy

ISBN 0-7778-6505-X

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THE LITTORAL ZONE BENTHIC MACROINVERTEBRATE COMMUNITIES OF 12 ACID-SENSITIVE HEADWATER LAKES IN SOUTH-CENTRAL ONTARIO: A SUMMARY OF THE FIRST FIVE YEARS

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EXECUTIVE SUMMARY

In 1988, the Aquatic Science Section of the Ontario Ministry of Environment and Energy (MOEE) initiated a programme to assess temporal trends in the benthic invertebrate communities of the littoral zones of a series of acid-sensitive, softwater lakes. The programme rationale, plus the field and laboratory protocols are described in companion documents that were produced in collaboration with the federal Department of Fisheries & Oceans (DFO) under the national Long Range Transport of Airborne Pollutants (LRTAP) biomonitoring programme. The principal objective of the LRTAP biomonitoring programme was to document changes in aquatic biota of selected lakes and rivers in eastern Canada in response to anticipated declines in sulphate deposition. In this report we summarize and compare the results of the first 5 years of the MOEE south-central Ontario component of the LRTAP study (i.e., 1988 - 1992).

Benthic macroinvertebrates in the littoral zones of 12 lakes were sampled using a timed, kick-and sweep protocol. Five sites in the nearshore area of each lake were selected using a stratified random sampling strategy. Site selection was based on the types of nearshore substrates such that the predominant substrates were represented in proportion to their relative frequency. Each of the lakes was sampled in the fall (i.e., September through November). Field protocols did not change over the 5 years of the study. Individual samples from each site were returned to the MOEE Dorset laboratory where the samples were sieved and the material retained by a 1000-µm sieve was preserved in alcohol. Subsequently, this material was stained for 48 hours, sorted in white porcelain trays, and all of the animals were removed. The resultant animals were identified

to the lowest practical taxonomic level; generally to the genus or species level.

These same 12 lakes were routinely sampled for a series of water-chemistry parameters. This water-chemistry data was summarized as ice-free season means and tabulated for each lake. The resultant chemistry data, information on lake morphology and data on the presence and absence of the fish species found in these lakes is tabulated in this report. Correlations between the water-chemistry parameters and several benthic macroinvertebrate indices are also presented.

The 5 years of data yielded from 177 to 214 genera, with an overall average of 195 genera from the 12 lakes. The five-year average number of genera was 84, ranging from 65 in Cradle Lake to 96 in Hamer Lake. For individual lakes, the number of genera ranged from 44 to 118 with a five-year average of 84 genera per lake. The total number of invertebrates collected from each lake in each year ranged from 1132 to 9220, with a five-year average of 4391. The five-year means of the Shannon-Wiener H' diversity indices ranged from a low of 1.01 in Young Lake to a high of 1.40 in Plastic Lake (where H' is calculated using logarithms to the base 10). The values for Young Lake had the largest standard deviation, whereas the values for Plastic Lake had the lowest standard deviation over the study. This suggests thta the benthic community of Young Lake was more variable than the nearshore benthic community in Plastic Lake.

The dominant taxonomic orders based on the total number of genera found in each lake were the Diptera (largely midges) and Trichoptera (caddisflies), followed by the Ephemeroptera (mayflies), Oligochaeta (aquatic earthworms) or Odonata (dragonflies and damselflies).

Typically about 40 dipteran genera were collected from each lake. Approximately 10-12 caddisfly genera, 6-12 odonate genera and 2-7 mayfly genera were also captured from each lake. Forty-five genera were found in all 12 lakes throughout the five-year study. These 45 ubiquitous taxa belonged to 9 different taxonomic groups. These taxa included dipterans, oligochaetes, leeches, amphipods, mayflies, odonates, caddisflies, snails and clams. Not surprising, the largest number of ubiquitous taxa belonged to the Diptera (i.e., 24 genera).

Based on the total number of individuals collected from the 5 sites in each lake, the Diptera also numerically dominated the nearshore benthos from all 12 lakes. The mayflies were the second-most common group in 9 of the lakes, whereas the caddisflies were the second-most numerous group in two lakes. The odonates were the second-most numerous group in only one lake. Thirty-seven genera were collected from only one lake, and hence, these taxa were classified as rare taxa. Of these 37 rare genera, none occurred in all 5 years. Only 8 of the 37 were encountered with abundances greater than 7 individuals.

Multivariate ordinations using correspondence analysis and the logarithmically transformed abundance data, as well as the presence - absence data, revealed that the benthic communities differed among lakes, but that the communities varied relatively little over the 5 years of the study. There were 5 recurring groups of similar lakes based on these ordinations. Blue Chalk, Hamer and Young lakes were generally clustered together. In addition, Pincher, Skidway and Harp lakes were similar with respect to their littoral benthic communities. Three pairs of lakes were also apparent: (1) Crosson and Westward; (2) Clear and Delano; and (3), Plastic and Cradle.

Based on the littoral benthic communities in these lakes, the pairs and small groups of lakes behaved similarly over the study. This consistency suggests that these data summarize nonrandom patterns that are relatively stable over time.

Of the 7 biological indices calculated from the benthic macroinvertebrate data, two metrics were largely uncorrelated with the various water-chemistry parameters. These indices included the total number of individuals and one of the multivariate metrics based on the presence - absence data. By contrast, the first and second axes of the logarithmically transformed abundance data ordination and the H' diversity index were correlated with more of the water-quality parameters. The second axis from the ordination of the presence - absence data and the total number of genera exhibited the most significant correlations ($P<0.05$) with the water-chemistry variables. Thus, those indices summarizing information relating to the number of genera were most frequently correlated with the water-chemistry parameters.

Calcium concentration, conductivity, potassium and sodium concentrations were consistently correlated with several of the biological indices over the 5 years of the study. As a result, the composition of the benthic community seems to reflect differences in water chamistry to a greater extent than the relative abundances of the different taxa. This finding is consistent with the view that synoptic surveys based on timed, kick-and-sweep sampling provide useful information on the numbers of different taxa present in an area, but the information based on the relative abundances of these taxa is of limited value. Future reports will assess time-trend aspects of these benthic data with respect to crayfish relative abundances and water chemistry.

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INTRODUCTION

In 1988 the Ontario Ministry of Environment and Energy (MOEE) initiated a biomonitoring programme to assess temporal trends in the composition of benthic macroinvertebrate communities in the nearshore areas of acid-sensitive, Precambrian Shield lakes. This MOEE study represented the south-central Ontario component of the federal-provincial Long Range Transport of Airborne Pollutants (LRTAP) programme. The collaborative federal-provincial effort was designed to assess anticipated improvements in the health of inland aquatic ecosystems associated with legislated reductions in sulphur emissions (Shaw et al. 1992). A standard set of survey protocols was used by members of the LRTAP programme to facilitate comparisons among data sets collected from 6 areas in eastern Canada (see Appendix 1 for a summary of these protocols). The goals of the LRTAP biomonitoring programme were: (1) to determine the regional distributions of common species of fish and benthic macroinvertebrates; (2) to compare temporal trends in the relative abundances of these species among lakes and among regions; and (3), to detect the response of these species to anticipated improvements in water chemistry associated with emission controls (Shaw et al. 1992, 1995).

This report summarizes the first 5 years of data collection for 12 small, headwater lakes in south-central Ontario. Herein we describe the physical, chemical and geological characteristics as well as the fish communities and the benthic macroinvertebrates found in these 12 lakes. In addition, we examine patterns in the littoral benthic community with respect to lake physical and chemical attributes.

STUDY AREA

All 12 of the study lakes are located in south-central Ontario in the county of Haliburton or in the Districts of Nipissing, Muskoka or Parry Sound. The nearest major urban centres are Peterborough (120 km) and Toronto (200 km) to the south and North Bay (130 km) and Sudbury (200 km) to the north (Figure 1). The lakes are scattered over an area that spans 78° 35' to 79° 52' in longitude and 45° 05' to 45° 34' in latitude (Table 1). In addition, the lakes range from an elevation of 221 to 510 m above sea level (i.e., m ASL).

Climate and Vegetation - Annual precipitation in the Dorset area ranges from 90-110 cm (over a 30-year period of record; Reid and Dillon 1994). This precipitation includes 240-300 cm of snow, such that the ground is generally snow covered between December 1 and April 10. January air temperatures average -10°C, whereas July air temperatures average 17.5°C. Mean annual air temperature is about 5°C. The lakes in the Dorset area are generally covered with ice from the first week of December to mid-April.

The study area is situated in the Great Lakes - St. Lawrence forest, a region characterized by white pine (*Pinus strobus*), red pine (*Pinus resinosa*), eastern hemlock (*Tsuga canadensis*) and yellow birch (*Betula alleghaniensis*). Other common species include beech (*Fagus grandifolia*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), basswood (*Tilia americana*), eastern white cedar (*Thuja occidentalis*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), white birch

(*Betula papyrifera*) and poplar (*Populus tremuloides*). Generally forest stands on the north-facing slopes are coniferous, whereas south-facing slopes are characterized by deciduous trees. Trees in the upland areas are predominately deciduous species. Coniferous trees are also common around the perimeter of each lake.

Geology - The study lakes are situated on the Canadian Shield, an expanse of Precambrian bedrock. The last period of mountain building of the Precambrian period was the Grenville orogeny which formed the Grenville province, a roughly rectangular strip of land 400 km wide and 2000 km long stretching from Georgian Bay to Labrador. The bedrock of the Grenville province is granitic in composition, usually composed of granitic gneisses and migmatites with marble, quartzite, amphibolite and various igneous intrusives (pegmatites, diorites and metabasics) of less importance (Jeffries and Snyder 1983). During the Pleistocene period, four glacial advances including the most recent or Wisconsin glaciation have rounded and polished the rock outcrops of the Grenville province. These glacial advances lowered the relief, scoured many river and lake basins and redeposited glacial debris, including moraines, eskers, outwash sands, gravel and lake sediments. Minor till plains (i.e., continuous moraine deposits >1 m thick) and thin till deposits (i.e., <1 m thick) interrupted by rock ridges are the dominant surficial deposits. Several of the study lakes were submerged beneath glacial Lake Algonquin (about 10,000 years ago) and received sediment-laden glacial runoff (Girard et al. 1985; Girard and Reid 1990; Reid and Snyder 1986).

METHODS

Lake and Site Selection - The 12 study lakes were selected from the MOEE water-chemistry database in order to span a range of alkalinities (i.e., buffering capacities) from <0 $\mu eq.L^{-1}$ to approximately 100 $\mu eq.L^{-1}$. The resultant lakes lie within the area bounded by Parry Sound, Gravenhurst and Algonquin Park (Figure 1). These lakes are all small, headwater lakes (i.e., 18 to 106 ha in area) that are located in a part of south-central Ontario where sulphate deposition is high (0.75 - 1.25 $g.m^{-2}.yr^{-1}$; Neary and Dillon 1988). Six of the lakes are located within the historic Lake Algonquin basin which was formed after the Wisconsin glaciation (i.e., Blue Chalk, Crosson, Hamer, Harp, Skidway and Young lakes). The other six lakes lie in the Algonquin - Haliburton Highlands (>340 m ASL; i.e., Clear, Cradle, Delano, Pincher, Plastic and Westward lakes).

In an initial survey in the spring of 1988, the field crew circumnavigated each lake and recorded the relative frequencies of various substrate types between the shore and a depth of approximately 1 m (Reid et al. 1994a). Subsequently, 5 sites were selected in proportion to the predominant nearshore substrates. Generally these sites were comprised of mixtures of bedrock, boulders, cobble, coarse sand and silt. In addition, some of these sites supported varying densities of macrophytes, plus overlying accumulations of organic detritus and woody debris (including logs). All of these sites were sampled in the spring of 1988, and they were re-sampled in the fall (Reid et al. 1994b). In the subsequent years the sites were only sampled in the fall. Only the fall-collected benthic data are compared in this report. Reid et al. (1994b) compared the results from the 1988 spring and fall surveys.

Sampling Procedures - Water Chemistry - Each year water samples were collected by an experienced MOEE sampling crew using the same field protocols. A complete description of the field methods has been published elsewhere (Girard and Reid 1990; Reid et al. 1994a, b). For most of the lakes, water samples were collected at monthly intervals throughout the ice-free season. These samples were collected as volume-weighted composites from the deepest spot in the lake. All samples were refrigerated and returned to the water chemistry laboratory at the Dorset Research Centre for analysis within 24 hours of collection. Routinely measured water-chemistry parameters included alkalinity (Alkt and Alkti), aluminum (Al), calcium (Ca), chloride (Cl), conductivity (Cond25), dissolved inorganic carbon (DIC), dissolved organic carbon (DOC), iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), sodium (Na), nitrogen (NH_4, NO_3 and TKN), pH, sulphate (SO_4) and total phosphorus (TP; see Appendix 3 for details). The resultant water-chemistry data are summarized as ice-free season means in this report. Young Lake proved to be an exception because water samples were only collected once in the fall in 1988 for that lake (Appendix 4).

Fish Community Inventory - The Ontario Ministry of Natural Resources (MNR) conducted lake surveys of the study lakes in order to determine the fish species that were present. Staff from the MNR offices in Bracebridge, Minden and Parry Sound provided these presence - absence data. These data are important because many fish species prey on the benthos, and hence, different combinations of fish species may affect the relative abundances of the littoral benthos (Post and Cucin 1984).

Fish were sampled with various types of gear including experimental gill nets, trapnets, Windermere traps, minnow traps and seine nets. Because the different types of gear tend to catch different fish species in different proportions, the individual catches were identified to species and the data were recorded as simple presence or absence. These data are listed for comparative purposes only.

Benthic Macroinvertebrates - Field Methods - The littoral benthos sampling followed a time-limited, kick-and-sweep protocol (Reid et al. 1994a, b; David et al. 1996). Because of site-specific differences in habitat complexity and sampling efficacy, the LRTAP group decided to collect benthic invertebrates with a kick-and-sweep method standardized to a constant period of time rather than a standard unit of area (see Reid et al. 1995 for further details). The rationale for using a fixed-time rather than a fixed-area sampling unit has been challenged because the area covered during a fixed period of time will vary depending on the habitat and water conditions. However, sampling is often limited to similar types of substrates in most fixed-area sampling programmes. Herein different types of substrates were selected *a priori*, so a general sampling method was required. Fixed-time sampling generally collects a large percentage of all species in proportion to their relative abundances (Elliott 1977). As a result, fixed-time sampling provides information on the relative abundances and species occurrences (i.e., presence and absence), whereas areal sampling estimates absolute abundance.

Littoral-zone macroinvertebrates were collected for 10 minutes at each site along a varying number of transects. Each transect extended perpendicular from shore to a maximum depth of 1

m. Individual transects were spaced 5-m apart to minimize overlap. On each transect the collector waded out to a depth of 1 m. The substrate was gently kicked to disturb and dislodge the surface sediment and associated detritus. The disturbed material was then swept up with a D-frame, 250-µm mesh net. The material in the net was periodically transferred to a plastic bucket as the collector waded slowly towards the shore (Reid et al. 1994a). After 10 minutes, a lid was placed on the bucket and the sample was labelled. Once all 5 sites were sampled, the buckets were returned to the biological laboratory at the Dorset Research Centre and refrigerated for a maximum of 24 hours.

Benthic Macroinvertebrates - Laboratory Sorting - In the laboratory, the samples in each bucket were sieved through 6250- and 1000-µm mesh to separate the coarse detritus and large invertebrates from the finer material. All of the >1000-µm fraction and any invertebrates retained by 6250-µm mesh were separately preserved in 70% ethanol. After several weeks the sieved fraction was stained for 48 hours to assist in removing the remaining macroinvertebrates from the debris (see Reid et al. 1994a, b for details). The samples were then rinsed to remove the excess dye. Subsamples of approximately 100 ml of debris were sorted in white porcelain trays to remove all of the remaining animals. Sorting and picking the entire sample of several litres of material generally required 4-to-8 hours. In the last few years of the study, several quality assurance - quality control (i.e., QA/QC) checks were undertaken to ensure that at least 95% of the animals were removed from the samples.

All of the animals were subsequently identified to the lowest practical taxonomic level by a professional taxonomist (i.e., Bohdan Bilyj, Biotax, Rexdale, ON). In most instances, the taxonomic resolution was to the genus or species level. Some larval invertebrates (e.g., chironomids) were distinguished as different species even though the exact species identification was not possible. These taxa were recorded according to the lowest taxonomic level followed by a unique number (e.g., *Bezzia* sp.1, *Bezzia* sp.2). When large numbers of some invertebrate groups were encountered (e.g., chironomids), approximately 300 individuals were subsampled for identification.

Statistical Analyses - Information on lake morphology, water chemistry and fish species presence-absence for each of the 12 lakes is tabulated in this report. Data on the nearshore substrates at each site are also tabulated. The benthic macroinvertebrate data were summarized using a variety of methods. Unfortunately, changes in the identifications of several species (i.e., corrections and updates; especially within the chironomid taxa) over the 5 years of the study led to minor incompatabilities from one year to the next. However, these incompatabilities disappeared when the counts for the individual species were agglomerated to the genus level. As a result, much of the statistical analysis was completed using the biological data rolled-up to the genus taxonomic level (see Reid et al. [1995] for further details).

Several summary indices were calculated at the genus level of taxonomic resolution. The total number of genera and total number of individuals were calculated for each lake and each year. Using this resolution, Shannon-Wiener diversity (H') and evenness (J') values were also calculated to compare the 12 lakes over the 5 survey years. The two diversity indices combine information on richness (i.e., the number of genera collected) and abundance (i.e., the number of individuals). The Shannon-Wiener index (H') was computed using the following formula:

$$H' = -\sum((n_i/N) \log (n_i/N))$$

where n_i is the number of individuals in genus "i" and N is the total number of individuals. A high diversity index means that similar numbers of individuals were found in each genus. A low value implies that most of the individuals that were collected belong to a few genera. In addition, we calculated evenness (J') using the formula:

$$J' = H' / H'_{max}$$

where H'_{max} equals the logarithm of the number of genera. Evenness is a standardized diversity index that ranges from 0 to 1. A benthic community with an evenness value near 1.0 would represent a community with a high diversity. That is, similar numbers of individuals in each of the different genera. By contrast, an evenness value near 0.0 would indicate a community where most of the individual organisms belonged to very few genera. Statistically significant differences among the lakes based on the H' diversity index were assessed using the formulas provided in Zar (1984). These formulas involve pair-wise comparisons between H' values for each lake and year (1988-1992).

The number of genera (i.e., richness), number of individuals and Shannon-Wiener diversity (H') were converted to Z-scores by subtracting the overall mean and dividing by the associated standard deviation. These Z-scores were plotted using scatterplots to search for groupings of similar lakes and to illustrate the extent of temporal variation in these 3 parameters over the 5 years. The number of genera and number of individual animals in the major taxonomic groups were also tabulated and ranked to determine which groups were most commonly encountered in the different lakes. Taxa found in only one lake during the study and taxa found in all 12 lakes over the 5 years were also identified and tabulated.

Multivariate summaries of the benthic macroinvertebrate data were obtained using correspondence analysis (NTSYS; Rohlf 1993). Correspondence analysis (CA) belongs to the family of ordination methods that includes principal components analysis. However, CA is the preferred ordination technique when summarizing species count data (see Reid et al. [1995] for details). In this context, CA is preferred because it utilizes a chi-squared measure of association which tends to provide a better summary of species inter-relationships along environmental gradients (Digby and Kempton 1987). In addition, CA is a more universal method because it can be used to summarize count data, logarithmically transformed count data and simple presence-absence data. With other types of ordination methods, different measures of association are recommended for each type of data (Digby and Kempton 1987; Rohlf 1993).

The counts from all 5 sites in each lake were combined using the genus level of taxonomic resolution to produce lake-by-year, by-genus matrices. The resultant matrices for each year were then ordinated using correspondence analysis. In this context, each successive CA axis represents a multivariate summary of the benthic community. These multivariate summaries position the lakes with respect to similarities and differences in the relative abundances of the different taxa. Lakes with similar proportions of the same taxa will lie next to each other in the ordination plot. To down-weight the importance of the numerically dominant taxa, the matrices of counts (i.e., relative abundances) were logarithmically transformed (using log base 10; i.e., log[X+1]) prior to the ordination. All 5 years of the data for all 12 lakes were analysed in a single CA ordination. Rare taxa (defined as those genera with less than 10 individuals and found in only 1 lake) were omitted from the analysis because CA can be unduly influenced by rare taxa (terBraak and Prentice 1988; Reid et al. 1995). The ordination scores for the 12 lakes were then plotted for each of the 5 years and these plots were compared to determine the degree of change among the relative positions of the 12 lakes over the 5 years.

This multivariate analysis was repeated after converting all of the counts (or relative abundances) to simple presence - absence information. The resultant CA based on the presence - absence data contrasts lakes with respect to the co-occurrences of the various genera. Separate plots for each year were also compared to determine if lakes that were similar to each other in one year changed over the course of the study. These types of shifts from one year to the next would indicate changes in the composition of the benthic community.

The analysis of the biological data produced 7 different summary metrics or indices. These metrics included the total number of genera, the total number of individuals, H' diversity (evenness was assumed to be redundant with H' diversity), the first two CA axes from the logarithmically transformed abundance data, and the first two CA axes from the presence - absence data. Each of these 7 biological metrics was correlated with the 19 water-chemistry parameters. The resultant Pearson product-moment correlations were based on 12 data points representing the values for each of the 12 lakes in a given year. These correlations were tabulated by year and then compared to identify statistically significant relationships ($P<0.05$). Given the 5 years of the study and the 19 chemical parameters, the resultant table included almost 100 correlations for each of the biological metrics. By definition, 5 of these correlations will be significant due to chance alone. As a result, this assessment was based on the number of significant correlations as well as the degree of consistency across the 5 years of the study.

RESULTS AND DISCUSSION

Lake and Site Description - The biomonitoring lakes are small (18-106 ha) headwater lakes in 4 tertiary watersheds in south-central Ontario (Table 1 and Figure 1; also see Cox 1978) . The four tertiary watersheds are:

1. 2EB - lakes in this watershed flow through the Moon River or the Go-Home River then into Georgian Bay and Lake Huron (i.e., Harp, Westward, Skidway, Young, Hamer and Pincher lakes);
2. 2EC - lakes in this watershed flow into the Severn River then into Georgian Bay and Lake Huron (i.e., Crosson and Blue Chalk lakes);
3. 2HF - lakes in this watershed flow into the Trent System from the Gull River and then to Lake Ontario (i.e., Clear and Plastic lakes); and
4. 2KD - lakes in this watershed flow into the St. Lawrence drainage basin via the Ottawa River and the Upper Madawaska River (i.e., Cradle and Delano lakes).

The nearshore substrate survey identified the predominant substrate types in order to select 5 littoral sites in each lake (Table 2; Appendix 5). Typical substrates included: detritus - a highly organic flocculent material; silt; coarse sand; pebbles; cobble; boulder and bedrock. Of the 60 sites, 19 sites were detritus dominated, 9 were a combination of detritus and coarse sand, 8 sites were coarse sand and cobble, and 4 sites were dominated by detritus and cobble. The remaining 20 sites had unique combinations of substrate types.

Water Chemistry - The conductivity, major ions and nutrient concentrations in the study lakes are typical of those observed in nutrient-poor, low-alkalinity Canadian Shield lakes (Reid et al. 1994a; and see Appendix 4). Conductivity ranged from 21 to 36 μS.cm^{-1} (Table 3). Alkalinity ranged from 3.3 to 100.2 μeq·L^{-1}. The lakes range from extremely sensitive (i.e., with acid-neutralizing capacity [ANC] values of less than 10 μeq·L^{-1}) to moderately sensitive (ANC <100 μeq·L^{-1}) to the potential for acidification. Lake pH ranged from 5.41 - 6.68 and sulphate ranged from 4.99 - 8.29 μg·L^{-1}.

Ten of the lakes were oligotrophic because of low nutrient concentrations (i.e., phosphorus and nitrogen; Dillon and Rigler 1974). Hamer Lake was marginally oligotrophic because the total phosphorus concentration was slightly above the 10 μg·L^{-1} threshold (Table 3). That is, total phosphorus and nitrogen (i.e., TKN or Total Kjeldahl Nitrogen) concentrations ranged from 3.70 - 11.17 μg·L^{-1} and 152 - 446 μg·L^{-1}, respectively. Dissolved organic carbon (i.e., DOC) ranged from a low of 1.48 mg·L^{-1} for Westward Lake to values characteristic of moderately coloured waters (e.g., 9.27 mg·L^{-1}) for Hamer Lake. Information on the year-to-year changes in water chemistry for each of the 12 lakes is summarized in Appendix 4.

Fish Community Inventory - The fish collections produced 26 species representing 9 taxonomic families (Gunn et al. 1988; Table 4). The white sucker (*Catostomus commersoni*) was the most ubiquitous species. It was caught in 10 of the 12 lakes. Three species were each caught in 6 lakes. These species included northern redbelly dace (*Phoxinus eos*), creek chub (*Semotilus atromaculatus*) and yellow perch (*Perca flavescens*). Lake trout (*Salvelinus namaycush*), pumpkinseed sunfish (*Lepomis gibbosus*) and pearl dace (*Semotilus margarita*) were caught in 5 lakes. Most of the other species were only found in one or two lakes.

Clear Lake had the most fish species (12), whereas Pincher Lake had only two species (i.e., white sucker and pearl dace; Table 4). Blue Chalk, Clear, Cradle, Delano and Harp lakes all supported lake trout populations, although the population in Delano Lake has declined dramatically over the past 20 years. The reason for this decline is not known (Monroe and Hicks 1985). Three lakes contained brook trout populations (*Salvelinus fontinalis*; i.e., Crosson, Harp and Westward lakes). Historically brook trout were also found in Plastic Lake. This lake gradually acidified in the early 1980s (Dillon et al. 1987). During that time, a population of crayfish (*Orconectes virilis*) disappeared from the lake (France and Collins 1993). As a result, changes in the fish community are also expected (e.g., see Gunn and Keller 1990; Keller et al. 1992).

Harp, Hamer and Young lakes all contained smallmouth bass populations (*Micropterus dolomieui*). By contrast, Skidway Lake was the only lake with a largemouth bass population

(*Micropterus salmoides*) and Plastic Lake supported a population of rock bass (*Ambloplites rupestris*). Brown bullheads (*Ictalurus nebulosus*) were caught in 4 of the lakes and burbot (*Lota lota*) were found in two lakes.

Littoral Benthic Macroinvertebrates - Each year the fall surveys yielded from 177 to 214 genera with an overall average of 195 genera from the 12 lakes. The five-year average number of genera was 84 ranging from 65 in Cradle Lake to 96 in Hamer (Table 5). For individual lakes the number of genera ranged from 44 (Cradle 1991) to 118 (Crosson 1992; Table 6). Similarly, the overall average number of individuals was 4391, ranging from 2249 in Cradle Lake to 6664 in Hamer Lake (Table 5). The number of individuals collected from each lake ranged from 1132 (Cradle 1991) to 9220 (Crosson 1992; Table 6). The abundance data for each lake and each year are tabulated in Appendix 6.

Plots of the Z-scores (i.e., the summary data rescaled to a mean of 0.0 and a standard deviation of 1.0 to simplify comparisons) for the total number of genera and the total number of individuals were examined to search for common patterns including temporal trends (Figure 2). Sets of 3 lakes were graphed in individual plots to reduce the overlap among the data points. Hamer, Crosson and Westward lakes generally had the highest Z-scores for both the number of genera and the number of individuals (Table 6). As a result, values for these 3 lakes generally fell in the upper right quadrant of the Z-score plots. By contrast, Cradle and Plastic lakes had lower numbers of genera and individuals so most of the observations for these two lakes fell in the left quadrants. The difference in H’ between these latter lakes places Cradle in the lower left quadrant and Plastic Lake in the upper left quadrant. On average, Skidway and Pincher lakes had relatively few genera, but lots of individuals. These two lakes were positioned in the upper left quadrant of the Z-score plots. Two other lakes, Harp and Delano, had more genera on average, but fewer individuals so they were plotted in the lower right quadrant.

Temporal trends in the number of genera and number of individuals were not evident; however, some lakes were more variable than others (e.g., Westward, Pincher and Cradle versus Harp, Plastic and Blue Chalk; see Figure 2). The reason for this difference in variability over the five-year survey is not known, although Westward, Pincher and Cradle lakes are 3 of the 4 highest elevation lakes in the study. Delano Lake is the fourth lake at an elevation above 400 m ASL (above sea level) and variation in these parameters in this lake was less pronounced.

Benthic Macroinvertebrate Diversity - The diversity indices combine information on richness (number of genera in a sample) and relative abundances (i.e., the total number of individuals). The five-year means revealed a relatively narrow range in H’ values from a low of 1.012 for Young Lake to a maximum of 1.404 for Plastic Lake (Table 5). The H’ values for Young Lake had the largest standard deviation (0.174), whereas Plastic Lake had the lowest variation over the 5 years (0.033). Clear, Blue Chalk and Cradle lakes all had similar average H’ values (i.e., 1.184, 1.198 and 1.203 respectively) and similar inter-annual variability (i.e., standard deviations of 0.066, 0.082 and 0.089, respectively). Harp, Crosson and Hamer lakes occupied the mid-range of diversity among the 12 lakes (see Table 6). However, the standard deviations for the H’ values for these lakes were the highest (0.143, 0.110 and 0.139, respectively), with the exception of Young Lake (0.174). Skidway Lake had the next largest diversity (1.265) and the third lowest variability. Delano and Westward lakes shared a similar average diversity (1.275 and 1.282) and variability (0.100 and 0.110, respectively). Pincher and Plastic lakes exhibited the highest diversity (i.e., 1.301 and 1.404) and almost the least inter-annual variation (i.e., 0.041 and 0.033). The difference in H' between these two lakes results from the fact that Plastic Lake has fewer individuals relative to the number of genera (2569 versus 74) when compared to Pincher Lake (5580 versus 70). By contrast, the average evenness values ranged from 0.520 in Young Lake to 0.753 in Plastic Lake (Table 5). Over the 5 years of the study, evenness values ranged from a low of 0.377 (Young 1992) to a high of 0.772 (Plastic 1991; Table 6). The overall average evenness value was 0.664 (Table 5).

The statistical comparison of the diversity values for the 12 lakes revealed a number of interesting patterns (Tables 7-11). For example, the diversity of the collections from Young Lake was almost always the lowest, whereas Plastic Lake generally was the highest. In 1988, the diversity of the Young Lake samples was significantly lower than any of the other lakes ($P<0.05$, Table 7). Similarly, Plastic Lake with the highest diversity was significantly different from all of the other lakes except Skidway ($P=0.0570$). Harp, Cradle and Delano lakes had similar diversities and Crosson, Blue Chalk, Westward and Clear lakes were not significantly different.

In 1989, Young Lake again had the lowest diversity, although it was not significantly different from the diversity of Clear Lake ($P=0.281$, Table 8). Blue Chalk, Skidway, Hamer, Westward, Harp and Clear lakes all had similar intermediate diversities ($P>0.05$). At the high end of the scale, Plastic, Crosson and Delano lakes all had similar diversities.

In 1990, Plastic and Westward lakes had the highest diversities (Table 9). Crosson Lake had the lowest diversity and it was similar to Clear and Blue Chalk lakes ($P>0.05$). In addition, Young, Skidway. Cradle, Harp, Delano and Hamer all formed a group of lakes with similar diversities. In 1991, the diversity of Westward Lake dropped to the lowest value for that year (Table 10). Plastic Lake still had the highest diversity. Westward and Young lakes were grouped together, as were Harp and Plastic at the other end of the scale. Cradle, Crosson, Clear, Skidway, Blue Chalk and Delano formed a group of lakes with intermediate diversities.

In 1992, Young Lake again had the lowest diversity and Plastic and Westward lakes had the highest values (Table 11). The diversity of Young Lake was significantly lower than the values for a group of lakes (Blue Chalk, Harp and Cradle) with the next lowest diversities. Skidway, Clear, Crosson, Pincher and Delano formed a group of lakes with intermediate diversities, whereas Hamer, Plastic and Westward lakes formed a group of lakes with similarly high diversity.

Z-score plots between H' diversity and the number of genera and the number of individuals revealed that H' was generally not correlated with either richness or abundance (Figure 2). In addition, many of the lakes illustrated very little variation in diversity over the 5 years. Cradle Lake was the lowest among the Z-score plot comparisons, while Hamer, followed closely by Westward, appear the most robust. Plastic Lake demonstrated a high H' diversity between these latter extremes, despite this similarity with Cradle Lake with lower than average number of genera and low abundance. Blue Chalk, Clear, Crosson, Delano, Harp and Young lakes generally oscillated about the overall means in all 3 sets of comparisons, although their number of individuals was slightly less than the overall average (with the exception of Crosson). Pincher and Skidway lakes were grouped together because they had fewer genera, a higher number of individuals and a higher than average H' diversity. In 1988, the Skidway Lake collections had more genera than the average, as well as a high abundance. This resulted in the second highest diversity for that year. Otherwise, Skidway Lake would normally rank close to the mean H' value of each year.

Correspondence Analysis - The ordinations of the log-transformed abundance data and the presence - absence data were plotted separately for each year. The scores for the 12 lakes on the first two CA axes were examined to search for clusters of lakes suggesting subsets of lakes with similar benthic communities. In these ordinations, the multivariate similarities among the benthic communities from the different lakes were evaluated at the genus level of taxonomic resolution.

From the log-abundance CAs, there were 5 recurring groups of lakes (Figure 3). For example, Blue Chalk, Hamer and Young lakes were generally grouped together at the positive end of CA axis I (i.e., CA I) with little or no influence from CA II. Similarly, Pincher, Skidway and Harp lakes were found at the negative end of CA I. However, this group of 3 lakes tended to vary in their positions on the second CA axis each year. Several pairs of similar lakes were also apparent over the 5 years. These pairs included: (1) Crosson and Westward; (2) Clear and Delano; and (3), Plastic and Cradle. These pairs of lakes shifted around on CA II axis while maintaining their pairing along CA I. These relatively consistent groups across the different years suggest that there are strong multivariate similarities among the lakes that were maintained over the 5 years of the study.

The presence - absence CA ordination produced similar groupings of lakes as in the log-abundance CA plots (Figure 4). In addition, the relative positions of the groups of lakes changed very little from one year to the next. The group of lakes represented by Skidway, Pincher and Harp remained in relatively close proximity in the presence - absence CA much like the log-abundance CA. Blue Chalk, Young and Hamer tended to group together, and so did the pairs of Delano and Clear, Plastic and Cradle, and Westward and Crosson. This relatively strong similarity between the two sets of ordinations suggests that the multivariate patterns are driven by differences in the taxonomic composition of the different sets of lakes, and not simply differences in relative abundances (see Reid et al. 1995 for a similar interpretation).

Ubiquitous and Rare Taxa - The dominant taxonomic orders based on the total number of genera for each lake were the Diptera and Trichoptera, followed by the Ephemeroptera (Blue Chalk and Young), Oligochaeta (Westward) or Odonata in the remaining 9 lakes (Table 12). The single exception was the Odonate group which had the second largest number of genera in Hamer Lake. Typically about 40 dipteran genera were collected from each lake. Similarly, 10-12 trichopteran genera were caught, along with 6-12 odonate genera. The ephemeroptera only included 2-7 genera. Relatively few odonate taxa were collected from Blue Chalk and Westward lakes.

Based on the total number of individuals collected from a given lake, the Diptera predominated the benthos from all 12 lakes (i.e., from 1150 to 4500 individuals on average; see Table 12). The Ephemeroptera were the second-most common group in 9 of the lakes (i.e., from 130 to 1600 individuals on average). The Trichoptera were the second-most numerous group in two lakes (Plastic and Skidway). Odonates were the second-most common group in Harp Lake. The third-ranked position varied across lakes. That is, the Coleoptera predominated in Blue Chalk and Delano lakes. The Trichoptera predominated in Clear, Cradle, Hamer and Pincher lakes. The Odonata predominated in Crosson, Plastic and Skidway lakes, whereas the Gastropoda were the third most-abundant group in Young Lake. As noted above, the second most-abundant group in Harp Lake was the Odonata, followed by the Ephemeroptera.

During this study 37 genera were collected from only one lake. As a result, these taxa are classified as rare (see Table 13). Of these 37 genera, none occurred in all 5 years and only 8 were found with abundances greater than 7 individuals. These latter 8 genera were found in only 6 lakes (Blue Chalk, Clear, Hamer, Harp, Skidway and Westward) and included isopods, amphipods, Tardigrada, a gastropod and several chironomids.

Forty-five different taxa were found in all 12 lakes throughout the five-year study (Table 14). These 45 ubiquitous taxa belonged to 9 different taxonomic groups. Several of these taxonomic groups had not been identified to the genus level. These combined groups included members within the dipteran Tanytarsini tribe, as well as the Oligochaeta. The remaining ubiquitous taxa included genera within the Hirudinea, Amphipoda, Ephemeroptera, Odonata, Trichoptera, Gastropoda, Pelecypoda and the Diptera. Not surprising, the largest number of ubiquitous genera belonged to the Diptera (i.e., 24 genera).

Environmental Correlates - Of the 7 biological metrics, two metrics had less than 5 statistically significant correlations with the 19 water-chemistry parameters over the 5 years of the study (Table 15). For example, the number of individuals was only significantly correlated with 4 of the water-chemistry parameters ($P<0.05$), and the first axis of the CA ordination of the presence - absence data only revealed one significant correlation. This small number of significant correlations approaches the number of non-trivial correlations expected by chance alone. As a result, these relationships will not be discussed because these correlations may simply represent a chance event. By contrast, the first and second axes of the log-abundance CA and H' diversity exhibited 7, 10 and 9 significant correlations, respectively. The second CA axis from the presence - absence data revealed 15 significant correlations, whereas the number of genera produced 21 significant correlations. These results suggest that the biological signal is associated with the presence and absence of different genera and not any of the metrics related to the abundance (or logarithmically transformed abundance) as represented by the number of individuals that were collected. This observation holds for both the simple metrics (e.g., number of genera versus the number of individuals) and the multivariate metrics (e.g., the presence - absence CA axes versus the log-abundance CA axes).

These correlations were also assessed with respect to the degree of consistency over the 5 years of the study (Table 15). For example, the total number of genera was significantly correlated with calcium concentration for 4 of the 5 years, suggesting that this relationship was not an artifact. Similarly, 3 of the 5 correlations between the number of genera and conductivity were significant. However, significant correlations with the remaining chemical parameters were only observed for one or two of the 5 years, suggesting that these were simply chance events.

The first CA axis from the ordination of the log-abundance data was significantly correlated with the dissolved inorganic carbon concentration for 3 of the 5 years (Table 15). However, none of the other correlations with this CA axis was significant more than once during the study. The second CA axis from this same ordination revealed 4 significant correlations with potassium concentration. No other consistent trends were observed for the results of this CA.

As noted above, the first axis from the CA of the presence - absence data only produced a single significant correlation with the 19 water-chemistry parameters (Table 15). However, this correlation was with dissolved inorganic carbon, the same parameter that was most-often correlated with the first CA axis from the log-abundance data. Upon further inspection, it is apparent that these two CA axes (i.e., CA I from both analyses) exhibit similar correlations with the same chemistry parameters suggesting that these two multivariate metrics reflect a similar pattern in the biological data.

The second CA axis from the presence - absence data was significantly correlated with potassium and sodium concentrations over all 5 years, and with conductivity for 4 of the 5 years (Table 15). Thus trends in the benthic community represented by the second presence - absence CA axis seem to reflect temporal changes in these 3 chemical parameters. Comparisons between the second CA axis from the presence - absence data and CA II for the log-abundance data suggests that these two axes summarize similar patterns. However, the multivariate summary based on the presence - absence ordination exhibits a somewhat stronger (or clearer) signal than that provided by the log-abundance CA results (e.g., compare Figures 3 and 4). Further interpretation of the inter-relationships between the biological metrics and the water-chemistry parameters will be the focus of a future report.

SUMMARY

This report summarizes the fall biomonitoring surveys conducted from 1988 to 1992 as part of the federal-provincial LRTAP biomonitoring programme. These synoptic surveys of the littoral benthos in 12 headwater lakes resulted in the collection of 263 different genera. On average, 4400 organisms representing 84 genera were collected from each lake on a given year. The Shannon-Wiener H' diversities for these data at the generic taxonomic level ranged from 0.740 (Young Lake in 1992) to 1.470 (Plastic 1991) with an average of 1.235. In these fall surveys, 37 unique genera were collected from only one of the 12 lakes. Of these 37 genera, none was found in all five years and only 8 were collected with abundances above 7 individuals in total. The 8 more-numerous rare genera were found in only 6 lakes (Blue Chalk, Clear, Hamer, Harp, Skidway and Westward).

Forty-five genera were collected from all 12 lakes throughout the study (i.e., 1988-1992). These 45 ubiquitous taxa belonged to 9 different taxonomic group representing oligochaetes (aquatic earthworms), Hirudinea (leeches), amphipods, Ephemeroptera (mayflies), Trichoptera (caddisflies), odonates (dragonflies and damselflies), Diptera (including Ceratopogonidae and Chironomidae, the midges), gastropods (snails) and pelecypods (clams).

Of the 7 biological indices calculated from these data, those parameters summarizing information relating to the number of genera were most frequently correlated with the various water-chemistry parameters. Calcium concentration, conductivity, potassium and sodium concentrations were consistently correlated with several of these biological metrics over the 5 years of the study. Indices incorporating information on the total number of individuals that were collected, including the H' diversity index, were rarely correlated with the water-chemistry parameters. As a result, the composition of the benthic community seems to reflect differences in the water chemistry of these lakes to a greater degree than the relative abundances of the different taxa. This finding is consistent with the belief that time-limited, kick-and-sweep sampling provides useful information on the number of different taxa present in an area, but the information pertaining to the relative abundances of these taxa is of limited value. Future reports will assess the time-trend aspects of these littoral-benthic data with respect to crayfish relative abundances in these same lakes, as well as the time-trends in the water-chemistry parameters.

ACKNOWLEDGEMENTS

This report summarizes the 1988 to 1992 surveys of 12 headwater lakes in south-central Ontario that comprise the MOEE component of the federal-provincial LRTAP programme. In this collaboration, we acknowledge colleagues from the federal Department of Fisheries and Oceans and Environment Canada, plus the Ontario Ministry of Natural Resources. We thank Greg Mierle and Peter Dillon for their supervision and encouragement. We also thank all of the members of the LRTAP programme who developed and implemented the biomonitoring protocols employed in this study. We thank the OMNR personnel who assisted with the fish inventory data including Lori McKay, Lois Deacon and Rick Hawkins. Bohdan Bilyj of Biotax in Rexdale identified and enumerated the invertebrates. Lastly, we also thank the many students and staff who assisted with the field collections and labour-intensive sample sorting.

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Table 1. Physical characteristics and location of the study lakes.

LAKE	LAT	LONG	COUNTY OR DISTRICT	TOWNSHIP	MAP[1]	AREA (ha)	WATERSHED CODES[2]	ELEVATION (m)
BLUE CHALK	45 12'	78 56'	MUSKOKA	RIDOUT	31E2	52.4	2EC15	336
CLEAR	45 11'	78 43'	HALIBURTON	SHERBORNE	31E2	88.4	2HF8	369
CRADLE	45 28'	78 35'	HALIBURTON	LAWRENCE	31E7	17.9	2KD18	472.4
CROSSON	45 05'	79 02'	MUSKOKA	OAKLEY	31E3	56.7	2EC15	312
DELANO	45 31'	78 36'	NIPISSING	CANISBAY	31E10	23.9	2KD1	442
HAMER	45 14'	79 48'	PARRY SOUND	HUMPHREY	31E4	35.2	2EB5	221
HARP	45 23'	79 04'	MUSKOKA	CHAFFEY	31E6	71.4	2EB13	327
PINCHER	45 34'	78 51'	NIPISSING	McCRANEY	31E10	42.1	2EB13	510.1
PLASTIC	45 11'	78 50'	HALIBURTON	SHERBORNE	31E2	32.1	2HF10	379
SKIDWAY	45 12'	79 52'	PARRY SOUND	CONGER	31E4	18.5	2EB2	221
WESTWARD	45 29'	78 47'	NIPISSING	PECK	31E4	63.3	2EB11	429
YOUNG	45 13'	79 33'	MUSKOKA	WATT	31E4	105.9	2EB7	251.5

[1] - Topographic map number (scale 1:50,000), [2] - Terrestrial watershed code from Cox (1978)

Table 2. Substrate description[1] of the 60 sites (12 lakes by 5 sites per lake). Substrate types are listed in descending rank order based on areal cover of the predominant substrates (see Appendix 4 for greater detail).

LAKE NAME	SITE NUMBER				
	1	2	3	4	5
BLUE CHALK	CSD/COB	LOS	LOS	CSD/PEB/LOS	CSD
CLEAR	CSD/COB	CSD/COB	CSD/LOS	CSD/COB	LOS
CRADLE	LOS/CSD/COB	LOS	COB/PEB/CSD/LOS	LOS	LOS
CROSSON	COB/PEB/CSD/LOS	LOS/COB/CSD	CSD/LOS	CSD/LOS	LOS/COB/CSD
DELANO	LOS	LOS/COB	LOS	LOS	BOU/LOS
HAMER	LOS	LOS/CSD	BDR	SLT/COB/LOS	LOS/SLT
HARP	LOS/CSD	COB/CSD	CSD/COB	CSD/COB	LOS/COB/PEB/CSD
PINCHER	COB/LOS	LOS	LOS/CSD/COB	LOS/COB	LOS
PLASTIC	COB/LOS/CSD	LOS	LOS	COB/CSD/SLT	LOS/COB/BOU
SKIDWAY	LOS	LOS	LOS	LOS	LOS/CSD
WESTWARD	LOS/CSD	LOS	CSD/LOS/COB	COB/CSD	LOS/CSD
YOUNG	CSD/PEB/SLT/LOS	CSD/LOS	CSD/LOS	SLT/LOS	CSD/LOS

[1] - BDR = Bedrock; BOU = Boulder; COB = Cobble, CSD = Coarse Sand; LOS = Organic Fines, PEB = Pebble, SLT = Silt

Table 3. Chemical parameters summarized as five-year, ice-free season means for the 12 lakes over the 1988-1992 period.

CHEMISTRY	LAKE CODE [2]											
PARAMETER[1]	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
Alkt (μeq·L^{-1})	122.30	43.42	43.34	47.64	81.80	50.98	105.21	38.14	42.36	40.41	83.77	132.94
Alkn (μeq·L^{-1})	88.21	8.10	8.69	14.42	49.50	20.61	72.38	3.31	7.79	6.36	49.34	100.23
Al (μg·L^{-1})	4.76	23.95	17.01	80.77	65.92	165.91	32.51	78.05	30.78	82.98	8.49	13.68
Ca (mg·L^{-1})	2.56	2.25	1.84	2.27	2.82	3.01	2.92	1.52	1.93	1.29	2.16	2.85
Cl (mg·L^{-1})	0.40	0.43	0.33	0.41	0.37	2.00	1.70	0.30	0.40	0.45	0.29	0.37
Cond25 (μS.cm^{-1})	28.39	25.38	22.13	26.56	32.13	32.79	36.21	21.10	22.19	19.00	24.19	30.73
DIC (mg·L^{-1})[1]	1.46	0.59	0.69	0.99	1.51	1.21	1.50	0.69	0.52	0.73	1.26	1.57
DOC (mg·L^{-1})[1]	1.75	1.60	1.51	4.27	5.18	9.27	3.63	2.61	2.08	3.57	1.48	3.17
Fe (μg·L^{-1})	63.12	29.05	96.40	294.11	245.39	414.37	63.90	112.75	78.32	397.90	99.94	35.87
K (mg·L^{-1})	0.38	0.35	0.29	0.31	0.40	0.48	0.56	0.40	0.21	0.34	0.36	0.56
Mg (mg·L^{-1})	0.76	0.55	0.48	0.64	0.94	0.65	0.94	0.44	0.47	0.41	0.59	0.76
Mn (μg·L^{-1})	31.20	45.00	33.21	38.26	76.47	39.29	17.16	59.84	45.90	74.71	90.47	39.39
Na (mg·L^{-1})	0.79	0.48	0.45	0.65	0.78	0.98	1.47	0.55	0.51	0.59	0.53	0.93
NH_4 (μg·L^{-1})	22.70	15.54	24.06	20.74	13.88	43.34	9.15	42.89	18.48	40.82	24.29	11.96
NO_3 (μg·L^{-1})	21.77	17.94	16.61	72.59	106.30	45.63	103.41	76.57	18.69	22.36	98.60	65.89
TKN (μg·L^{-1})	184.96	152.09	173.45	284.02	277.42	445.50	218.29	241.52	177.14	318.92	166.52	228.93
pH	6.68	5.79	5.73	5.60	6.05	5.41	6.36	5.43	5.75	5.43	6.34	6.66
SO_4 (mg·L^{-1})	6.27	7.80	6.68	7.43	8.29	6.74	7.45	6.10	6.58	4.99	5.97	6.46
TP (μg·L^{-1})[1]	5.63	3.70	6.42	9.73	7.47	11.17	6.85	5.21	5.06	8.53	4.01	8.11

[1] - for explanations see text. Alkt - Alkalinity fixed end point (pH = 4.5), Alkn - Alkalinity Gran titration (Inflection Point),
DIC - Dissolved Inorganic Carbon, DOC - Dissolved Organic Carbon, TP - Total Phosphorus

[2] - Lake Codes: BC - Blue Chalk, CL - Clear, CR - Cradle, CN - Crosson, DO - Delano; HR - Hamer, HP - Harp, PN - Pincher,
PC - Plastic, SY - Skidway, WD - Westward, YG - Young

Table 4. Fish community (Presence - Absence) inventory for the 12 lakes.

SCIENTIFIC AND COMMON NAMES		LAKE CODE[1]											
		BC	CL	CR	CN	DO	HR	HP	PC	PN	SY	WD	YG
Family Salmonidae													
Subfamily Salmoninae													
Salvelinus fontinalis	Brook Trout	A	A	A	P	A	A	P	A	A	A	P	A
Salvelinus namaycush	Lake Trout	P	P	P	A	P	A	P	A	A	A	A	A
Subfamily Coregoninae													
Coregonus artedii	Cisco	A	A	A	A	A	A	P	A	A	A	A	P
Family Osmeridae													
Osmerus mordax	Rainbow Smelt	A	A	P	A	A	A	A	P	A	A	A	A
Family Catostomidae													
Catostomus commersoni	White Sucker	P	P	A	P	P	A	P	P	P	P	P	P
Family Cyprinidae													
Phoxinus eos	N. Redbelly Dace	P	P	P	A	P	A	A	P	A	A	P	A
Couesius plumbeus	Lake Chub	A	P	A	A	A	A	A	A	A	A	P	A
Hybognathus hankinsoni	Brassy Minnow	P	A	A	A	A	A	A	A	A	A	A	A
Notemigonus crysoleucas	Golden Shiner	P	A	A	P	A	A	A	P	A	A	A	A
Notropis cornutus	Common Shiner	A	P	A	A	P	A	A	A	A	A	P	A
Notropis heterodon	Blackchin Shiner	P	A	A	A	A	A	A	A	A	A	A	A
Notropis heterolepis	Blacknose Shiner	A	A	A	P	A	A	A	A	A	A	P	A
Pimephales notatus	Bluntnose Minnow	A	P	A	A	A	A	A	A	A	A	A	P
Pimephales promelas	Fathead Minnow	A	P	A	A	A	A	A	A	A	A	P	A
Rhinichthys atratulus	Blacknose Dace	A	P	A	A	A	A	A	A	A	A	A	A
Semotilus atromaculatus	Creek Chub	P	P	P	P	P	A	A	P	A	A	A	A
Semotilus margarita	Pearl Dace	A	P	P	A	P	A	A	P	P	A	A	A
Family Ictaluridae													
Ictalurus nebulosus	Brown Bullhead	P	A	A	P	A	P	A	P	A	A	A	A
Family Gadidae													
Lota lota	Burbot (ling)	P	A	A	A	A	A	P	A	A	A	A	A
Family Gasterosteidae													
Culaea inconstans	Brook Stickleback	A	A	P	A	P	A	A	A	A	A	P	A
Family Centrarchidae													
Ambloplites rupestris	Rock Bass	A	A	A	A	A	A	A	P	A	A	A	A
Lepomis gibbosus	Pumpkinseed	P	P	A	P	A	A	A	P	A	P	A	A
Micropterus dolomieui	Smallmouth Bass	A	A	A	A	A	P	P	A	A	A	A	P
Micropterus salmoides	Largemouth Bass	A	A	A	A	A	A	A	A	A	P	A	A
Family Percidae													
Perca flavescens	Yellow Perch	A	P	A	P	A	P	A	P	A	P	A	P
Etheostoma exile	Iowa Darter	A	A	A	A	A	A	A	A	A	A	A	P
Total Number of Species		10	12	6	8	7	3	6	10	2	4	8	6

[1] - Lake names: BC = Blue Chalk, CL = Clear, CR = Cradle, CN = Crosson, DO = Delano, HR = Hamer, HP = Harp, PC = Plastic, PN = Pincher, SY = Skidway, WD = Westward, YG = Young

Table 5. Summary of the among-year variation in the biological metrics for the 12 lakes over the five-year period (i.e., means and standard deviations).

LAKE NAME	BIOLOGICAL METRIC							
	# OF INDIVIDUALS		# OF GENERA		H'		J'	
	MEAN	STD	MEAN	STD	MEAN	STD	MEAN	STD
BLUE CHALK	2967	996	86	4	1.1975	0.0828	0.6201	0.0466
CLEAR	4419	1413	86	7	1.1840	0.0662	0.6117	0.0305
CRADLE	2249	1016	65	11	1.2034	0.0893	0.6699	0.0713
CROSSON	5691	1812	95	13	1.2305	0.1095	0.6230	0.0506
DELANO	3191	937	90	5	1.2747	0.0995	0.6515	0.0465
HAMER	6664	1089	96	10	1.2504	0.1393	0.6308	0.0634
HARP	3351	540	92	8	1.2199	0.1430	0.6216	0.0683
PINCHER	5580	2286	70	8	1.3010	0.0408	0.7064	0.0236
PLASTIC	2569	618	74	6	1.4043	0.0328	0.7530	0.0160
SKIDWAY	5951	1757	76	11	1.2647	0.0569	0.6754	0.0328
WESTWARD	5633	2337	83	7	1.2818	0.1100	0.6685	0.0526
YOUNG	4426	1640	90	11	1.0122	0.1737	0.5195	0.0924
OVERALL MEAN	4391	1370	84	8	1.2354	0.0953	0.6460	0.0496
OVERALL STD	1435	576	10	3	0.0879	0.0410	0.0550	0.0211

Table 6. Taxonomic richness, abundance, diversity and evenness values with Z-scores for the benthic invertebrate collections.

LAKE NAME	YEAR	BIOLOGICAL METRIC							
		RAW VALUES				Z-SCORE			
		GENERA	INDIVID	H'	J'	GENERA	INDIVID	H'	J'
BLUE CHALK	1988	86	3552	1.192	0.616	0.530	-0.330	0.217	-0.088
	1989	87	2785	1.291	0.666	0.420	-0.950	-0.186	0.979
	1990	84	4458	1.151	0.598	0.600	0.040	-0.861	-0.468
	1991	80	1486	1.283	0.674	-0.340	-1.240	-0.053	1.153
	1992	91	2555	1.071	0.547	0.080	-0.900	-0.712	-1.576
CLEAR	1988	79	2851	1.225	0.645	-0.350	-0.680	0.452	1.106
	1989	78	5058	1.101	0.582	-0.240	0.110	-1.983	-0.989
	1990	89	6819	1.112	0.571	1.160	1.350	-1.326	-1.350
	1991	96	3311	1.270	0.641	0.590	-0.320	-0.191	0.945
	1992	90	4054	1.213	0.621	0.000	-0.240	0.106	0.288
CRADLE	1988	73	3190	1.085	0.582	-1.110	-0.510	-0.546	-1.232
	1989	61	1227	1.348	0.755	-1.500	-1.680	0.348	1.195
	1990	75	3644	1.203	0.642	-0.420	-0.410	-0.237	-0.395
	1991	44	1132	1.238	0.753	-2.430	-1.420	-0.535	1.166
	1992	71	2053	1.143	0.618	-1.460	-1.120	-0.293	-0.733
CROSSON	1988	82	4915	1.173	0.613	0.030	0.350	0.086	-0.195
	1989	97	5425	1.420	0.715	1.160	0.280	1.025	1.811
	1990	82	4756	1.089	0.569	0.370	0.210	-1.602	-1.062
	1991	97	4138	1.255	0.632	0.650	0.100	-0.349	0.172
	1992	118	9220	1.215	0.586	2.150	2.060	0.119	0.725
DELANO	1988	83	2189	1.128	0.588	0.150	-1.010	-0.240	-1.377
	1989	95	4758	1.432	0.724	1.010	-0.030	1.134	1.554
	1990	93	3644	1.234	0.627	1.610	-0.410	0.133	-0.530
	1991	86	2359	1.314	0.679	0.010	-0.800	0.281	0.593
	1992	95	3005	1.267	0.640	0.380	-0.700	0.418	-0.240
HAMER	1988	86	7923	0.979	0.506	0.530	1.850	-1.297	-1.968
	1989	91	6222	1.328	0.678	0.720	0.650	0.157	0.741
	1990	87	4943	1.261	0.650	0.930	0.310	0.450	0.301
	1991	111	6494	1.329	0.650	1.470	1.290	0.440	0.294
	1992	105	7740	1.356	0.671	1.150	1.400	0.934	0.632

Table 6 cont'd. Taxonomic richness, abundance, diversity and evenness values with Z-scores for the benthic invertebrate collections.

LAKE NAME	YEAR	BIOLOGICAL METRIC							
		RAW VALUES				Z-SCORE			
		GENERA	INDIVID	H'	J'	GENERA	INDIVID	H'	J'
HARP	1988	83	4334	1.052	0.548	0.150	0.060	-0.775	-1.072
	1989	98	2821	1.345	0.675	1.240	-0.940	0.315	0.785
	1990	82	3505	1.213	0.634	0.370	-0.480	-0.124	0.176
	1991	97	3008	1.414	0.712	0.650	-0.470	1.361	1.320
	1992	99	3089	1.076	0.539	0.690	-0.660	-0.683	-1.208
PINCHER	1988	62	2819	1.284	0.716	-2.510	-0.700	0.873	0.420
	1989	71	8730	1.360	0.735	-0.760	1.820	0.025	1.201
	1990	62	3087	1.292	0.721	-1.880	-0.720	0.026	0.603
	1991	83	6915	1.329	0.693	-0.160	1.500	-0.061	-0.590
	1992	72	6350	1.241	0.668	-1.380	0.780	0.211	-1.634
PLASTIC	1988	77	3306	1.390	0.737	-0.610	-0.450	1.627	-1.020
	1989	63	2006	1.386	0.770	-1.360	-1.320	-1.852	1.083
	1990	70	1813	1.386	0.751	-0.980	-1.420	-1.289	-0.127
	1991	80	2465	1.470	0.772	-0.340	-0.750	-1.176	1.208
	1992	78	3253	1.390	0.735	-0.920	-0.590	-0.290	-1.145
SKIDWAY	1988	92	8912	1.345	0.685	1.290	2.340	1.310	0.294
	1989	61	5437	1.301	0.729	-1.500	0.280	0.461	1.627
	1990	67	4597	1.199	0.657	-1.310	0.120	0.823	-0.575
	1991	77	3996	1.277	0.677	-0.510	0.030	0.444	0.044
	1992	81	6814	1.202	0.630	-0.690	0.990	0.268	-1.390
WESTWARD	1988	91	3328	1.199	0.612	1.160	-0.440	0.270	-1.073
	1989	84	6189	1.340	0.697	0.200	0.630	0.707	0.532
	1990	79	8751	1.340	0.706	0.030	2.420	1.950	0.718
	1991	72	7298	1.113	0.599	-0.800	1.690	1.957	-1.320
	1992	88	2600	1.417	0.729	-0.150	-0.880	1.130	1.144
YOUNG	1988	87	3244	0.883	0.456	0.660	-0.480	-1.977	-0.692
	1989	90	7321	1.082	0.554	0.640	1.160	-0.095	0.369
	1990	74	2542	1.196	0.640	-0.530	-1.020	-0.289	1.300
	1991	107	4746	1.160	0.572	1.230	0.400	-0.116	0.565
	1992	92	4278	0.740	0.377	0.150	-0.140	0.045	-1.542

Table 7. The 1988 diversity-evenness (H', J') results for the 12 lakes with the corresponding pair-wise matrix of between-lake comparisons using H'. Values above the diagonal are t values and their associated probabilities are below the diagonal. For a single comparison t=1.972 @ P=0.05; given 66 multiple comparisons, the Bonferroni adjusted t value to maintain an overall probability of 0.05 is t>3.340.

LAKE NAME			LAKE CODE											
	H'	J'	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
BLUE CHALK	1.192	0.616	--- ---	1.353	2.519	1.070	1.803	3.754	2.830	2.418	3.650	3.334	0.649	3.927
CLEAR	1.225	0.645	0.201	--- ---	2.847	1.763	2.199	3.976	3.113	1.911	3.282	2.903	1.193	4.093
CRADLE	1.085	0.582	0.027	0.015	--- ---	2.406	1.500	2.721	1.389	3.653	4.668	4.500	2.608	3.219
CROSSON	1.173	0.613	0.308	0.103	0.033	--- ---	1.576	3.818	2.759	2.803	4.070	3.809	1.268	3.933
DELANO	1.128	0.588	0.096	0.048	0.159	0.141	--- ---	2.909	1.960	2.938	3.888	3.638	1.906	3.335
HAMER	0.979	0.506	0.003	0.003	0.019	0.003	0.014	--- ---	2.223	4.869	5.910	5.937	3.825	2.314
HARP	1.052	0.548	0.016	0.010	0.190	0.018	0.073	0.046	--- ---	3.864	4.806	4.652	2.908	2.917
PINCHER	1.284	0.716	0.033	0.080	0.004	0.017	0.013	0.001	0.003	--- ---	2.900	2.328	2.322	4.663
PLASTIC	1.390	0.737	0.004	0.007	0.001	0.002	0.003	0.000	0.001	0.014	--- ---	2.104	3.587	5.354
SKIDWAY	1.345	0.685	0.007	0.014	0.001	0.003	0.004	0.000	0.001	0.038	0.057	--- ---	3.259	5.246
WESTWARD	1.199	0.612	0.536	0.257	0.023	0.230	0.081	0.003	0.014	0.039	0.005	0.008	--- ---	3.973
YOUNG	0.883	0.456	0.003	0.002	0.008	0.003	0.007	0.039	0.014	0.001	0.001	0.001	0.003	--- ---

Table 8. The 1989 diversity-evenness (H', J') results for the 12 lakes with the corresponding pair-wise matrix of between-lake comparisons using H'. Values above the diagonal are t values and their associated probabilities are below the diagonal. For a single comparison t=1.972 @ P=0.05; given 66 multiple comparisons, the Bonferroni adjusted t value to maintain an overall probability of 0.05 is t>3.340.

LAKE NAME			LAKE CODE											
	H'	J'	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
BLUE CHALK	1.291	0.666	--- ---	3.305	1.701	2.892	2.999	1.521	1.701	2.179	2.374	0.806	1.813	3.565
CLEAR	1.101	0.582	0.007	--- ---	3.705	4.901	4.945	4.070	3.825	4.603	4.372	3.963	4.344	1.133
CRADLE	1.348	0.755	0.114	0.004	--- ---	2.118	2.268	1.115	0.436	0.890	1.479	1.739	0.713	3.949
CROSSON	1.420	0.715	0.014	0.001	0.056	--- ---	1.039	2.905	2.284	2.576	1.648	3.501	2.879	5.313
DELANO	1.432	0.724	0.012	0.001	0.043	0.322	--- ---	3.042	2.434	2.762	1.891	3.609	3.031	5.346
HAMER	1.328	0.678	0.154	0.002	0.289	0.014	0.011	--- ---	1.062	1.834	2.129	1.614	1.105	4.447
HARP	1.345	0.675	0.114	0.003	0.674	0.041	0.032	0.312	--- ---	1.075	1.614	1.764	0.555	4.098
PINCHER	1.360	0.735	0.050	0.001	0.604	0 025	0.018	0.091	0.306	--- ---	1.518	2.684	1.567	5.076
PLASTIC	1.386	0.770	0.035	0.001	0.165	0.125	0.083	0.054	0.132	0.155	--- ---	2.680	1.974	4.699
SKIDWAY	1.301	0.729	0.558	0.003	0.107	0.005	0.004	0.132	0.103	0.020	0.021	--- ---	2.103	4.389
WESTWARD	1.340	0.697	0.094	0.002	0.503	0.015	0.011	0.293	0.595	0.143	0.072	0.057	--- ---	4.780
YOUNG	1.082	0.554	0.005	0.281	0.003	0.000	0.000	0.001	0.002	0.001	0.001	0.001	0.001	--- ---

Table 9. The 1990 diversity-evenness (H', J') results for the 12 lakes with the corresponding pair-wise matrix of between-lake comparisons using H'. Values above the diagonal are t values and their associated probabilities are below the diagonal. For a single comparison t=1.972 @ P=0.05; given 66 multiple comparisons, the Bonferroni adjusted t value to maintain an overall probability of 0.05 is t>3.340.

LAKE NAME			LAKE CODE											
	H'	J'	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
BLUE CHALK	1.151	0.598	--- ---	1.641	1.843	1.995	2.221	2.729	1.922	3.120	3.747	1.850	3.900	1.549
CLEAR	1.112	0.571	0.126	--- ---	2.572	1.282	2.811	3.371	2.568	3.749	4.229	2.664	4.670	2.200
CRADLE	1.203	0.642	0.090	0.025	--- ---	2.765	1.382	2.024	0.770	2.538	3.366	0.570	3.436	0.655
CROSSON	1.089	0.569	0.069	0.225	0.018	--- ---	2.966	3.465	2.753	3.801	4.259	2.849	4.585	2.420
DELANO	1.234	0.627	0.046	0.016	0.192	0.012	--- ---	1.298	1.107	1.932	2.938	1.536	2.798	1.418
HAMER	1.261	0.650	0.019	0.006	0.066	0.005	0.219	--- ---	1.759	1.545	2.840	2.221	2.719	1.933
HARP	1.213	0.634	0.078	0.025	0.537	0.018	0.292	0.104	--- ---	2.277	3.154	0.967	3.092	0.950
PINCHER	1.292	0.721	0.010	0.004	0.026	0.003	0.077	0.148	0.042	--- ---	2.481	2.758	2.160	2.365
PLASTIC	1.386	0.751	0.004	0.002	0.006	0.002	0.013	0.016	0.009	0.029	--- ---	3.550	1.837	3.153
SKIDWAY	1.199	0.657	0.089	0.021	0.586	0.015	0.150	0.046	0.644	0.018	0.005	--- ---	3.806	0.450
WESTWARD	1.340	0.706	0.003	0.001	0.006	0.001	0.017	0.019	0.010	0.052	0.091	0.003	--- ---	3.052
YOUNG	1.196	0.640	0.147	0.048	0.532	0.033	0.182	0.076	0.635	0.036	0.009	0.664	0.011	--- ---

Table 10. The 1991 diversity-evenness (H', J') results for the 12 lakes with the corresponding pair-wise matrix of between-lake comparisons using H'. Values above the diagonal are t values and their associated probabilities are below the diagonal. For a single comparison t=1.972 @ P=0.05; given 66 multiple comparisons, the Bonferroni adjusted t value to maintain an overall probability of 0.05 is t>3.340.

LAKE NAME			LAKE CODE											
	H'	J'	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
BLUE CHALK	1.283	0.674	--- ---	0.781	1.414	1.143	1.165	1.514	2.495	1.555	3.015	0.536	2.950	2.376
CLEAR	1.270	0.641	0.543	--- ---	1.357	0.970	1.563	2.042	3.039	2.147	3.663	0.691	3.426	2.588
CRADLE	1.238	0.753	0.183	0.200	--- ---	0.999	1.972	2.382	3.186	2.473	3.724	1.535	2.849	2.072
CROSSON	1.255	0.632	0.277	0.645	0.659	--- ---	1.806	2.285	3.192	2.401	3.798	1.215	3.264	2.409
DELANO	1.314	0.679	0.268	0.144	0.072	0.096	--- ---	0.940	2.361	0.985	2.996	1.466	3.535	2.871
HAMER	1.329	0.650	0.156	0.064	0.035	0.041	0.630	--- ---	2.467	0.203	3.265	1.991	4.331	3.366
HARP	1.414	0.712	0.028	0.011	0.009	0.009	0.036	0.030	--- ---	2.577	1.932	3.055	4.750	3.944
PINCHER	1.329	0.693	0.146	0.053	0.030	0.034	0.652	0.837	0.038	--- ---	3.436	2.112	4.665	3.513
PLASTIC	1.470	0.772	0.011	0.004	0.004	0.003	0.012	0.008	0.002	0.006	--- ---	3.722	5.347	4.451
SKIDWAY	1.277	0.677	0.608	0.510	0.150	0.249	0.168	0.070	0.521	0.056	0.004	--- ---	3.654	2.745
WESTWARD	1.113	0.599	0.013	0.006	0.015	0.008	0.005	0.002	0.002	0.001	0.000	0.004	--- ---	1.832
YOUNG	1.160	0.572	0.035	0.024	0.060	0.033	0.015	0.006	0.011	0.005	0.001	0.018	0.091	--- ---

Table 11. The 1992 diversity-evenness (H', J') results for the 12 lakes with the corresponding pair-wise matrix of between-lake comparisons using H'. Values above the diagonal are t values and their associated probabilities are below the diagonal. For a single comparison t=1.972 @ P=0.05; given 66 multiple comparisons, the Bonferroni adjusted t value to maintain an overall probability of 0.05 is t>3.340.

LAKE NAME			LAKE CODE											
	H'	J'	BC	CL	CR	CN	DO	HR	HP	PN	PC	SY	WD	YG
BLUE CHALK	1.071	0.547	--- ---	2.691	1.859	2.843	3.109	4.004	0.467	3.120	4.131	2.714	4.185	3.948
CLEAR	1.213	0.621	0.020	--- ---	2.006	0.412	1.824	3.315	2.664	1.493	3.524	0.901	3.614	5.206
CRADLE	1.143	0.618	0.087	0.068	--- ---	2.169	2.619	3.748	1.806	2.569	3.901	1.966	3.963	4.602
CROSSON	1.215	0.586	0.015	0.690	0.051	--- ---	1.918	3.712	2.818	1.638	3.857	1.118	3.885	5.546
DELANO	1.267	0.640	0.010	0.093	0.023	0.079	--- ---	2.520	3.091	1.383	2.847	2.144	3.018	5.378
HAMER	1.356	0.671	0.002	0.007	0.004	0.004	0.027	--- ---	4.005	3.472	1.702	3.884	2.135	6.324
HARP	1.076	0.539	0.653	0.021	0.096	0.016	0.010	0.002	--- ---	3.103	4.132	2.687	4.185	4.003
PINCHER	1.241	0.668	0.010	0.161	0.025	0.127	0.192	0.005	0.010	--- ---	3.653	2.007	3.699	5.777
PLASTIC	1.390	0.735	0.002	0.005	0.003	0.003	0.015	0.114	0.002	0.004	--- ---	4.001	1.359	6.284
SKIDWAY	1.202	0.630	0.019	0.610	0.073	0.287	0.053	0.003	0.020	0.068	0.002	--- ---	4.010	5.474
WESTWARD	1.417	0.729	0.002	0.004	0.003	0.003	0.011	0.054	0.002	0.004	0.200	0.002	--- ---	6.192
YOUNG	0.740	0.377	0.003	0.001	0.001	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	--- ---

Table 12. Listing of the dominant benthic taxa ranked by number of genera and number of individuals.

LAKE NAME	NUMBER OF GENERA						LAKE NAME	NUMBER OF INDIVIDUALS					
	1988	1989	1990	1991	1992	AVG		1988	1989	1990	1991	1992	AVG
BLUE CHALK							BLUE CHALK						
DIPTERA	41	40	39	38	41	39.8	DIPTERA	1305	1187	1719	730	814	1151.0
Trichoptera	9	10	10	10	12	10.2	Ephemeroptera	598	298	363	117	290	333.2
Ephemeroptera	7	7	7	6	8	7.0	Coleoptera	77	109	221	62	42	102.2
Coleoptera	5	5	4	4	4	4.4	Trichoptera	76	64	72	24	69	61.0
CLEAR							CLEAR						
DIPTERA	37	31	40	43	40	38.2	DIPTERA	872	1455.3	1994	1476	1335	1426.5
Trichoptera	10	14	11	15	15	13.0	Ephemeroptera	541	584	789	634	252	560.0
Odonata	9	12	9	11	8	9.8	Trichoptera	90	275	183	75	120	148.6
Ephemeroptera	5	5	6	4	4	4.8	Odonata	55	85	65	26	43	54.8
CRADLE							CRADLE						
DIPTERA	32	26	38	26	39	32.2	DIPTERA	1646	682	3101	1025	1821	1655.0
Trichoptera	14	8	9	4	9	8.8	Ephemeroptera	355	169	121	23	20	137.6
Odonata	8	7	5	6	5	6.2	Trichoptera	36	47	125	38	23	53.8
Ephemeroptera	5	4	5	3	4	4.2	Odonata	26	59	26	16	18	29.0
CROSSON							CROSSON						
DIPTERA	31	35	36	47	50	39.8	DIPTERA	1627	3085	1491	1323	4040	2313.2
Trichoptera	10	14	11	13	19	13.4	Ephemeroptera	805	762	405	907	1218	819.4
Odonata	12	8	11	10	13	10.8	Odonata	324	148	370	176	237	251.0
Ephemeroptera	6	6	6	6	7	6.2	Trichoptera	142	103	240	141	528	230.8
DELANO							DELANO						
DIPTERA	39	41	45	38	46	41.8	DIPTERA	499	2450.1	1324	860	1721	1370.8
Trichoptera	11	12	10	14	16	12.6	Ephemeroptera	768	858	309	210	194	467.8
Odonata	11	10	10	11	11	10.6	Coleoptera	18	175	267	209	70	147.8
Ephemeroptera	5	5	6	6	4	5.2	Odonata	136	129	173	227	72	147.4
Coleoptera	3	8	5	4	2	4.4	Trichoptera	38	132	53	83	81	77.4
HAMER							HAMER						
DIPTERA	37	38	43	54	48	44.0	DIPTERA	1521	2153	1326	2526	3260	2157.2
Odonata	12	14	11	13	14	12.8	Ephemeroptera	1672	1552	1283	2489	991	1597.4
Trichoptera	10	12	11	13	14	12.0	Trichoptera	406	420	308	379	648	432.2
Ephemeroptera	5	4	5	3	4	4.2	Odonata	314	389	203	236	257	279.8

Table 12 cont'd. Listing of the dominant benthic taxa ranked by number of genera and number of individuals.

LAKE NAME	NUMBER OF GENERA						LAKE NAME	NUMBER OF INDIVIDUALS					
	1988	1989	1990	1991	1992	AVG		1988	1989	1990	1991	1992	AVG
HARP							HARP						
DIPTERA	34	44	31	44	43	39.2	DIPTERA	1043	1180	1081	1678	814	1159.2
Trichoptera	10	13	9	9	13	10.8	Odonata	346	122	265	205	160	219.6
Odonata	9	8	8	7	8	8.0	Ephemeroptera	324	147	306	121	158	211.2
Ephemeroptera	6	5	6	7	6	6.0	Trichoptera	77	57	63	71	76	68.8
PINCHER							PINCHER						
DIPTERA	27	29	27	43	34	32.0	DIPTERA	1652	5644.7	1952	5707	4633	3917.7
Trichoptera	8	13	11	9	13	10.8	Ephemeroptera	451	930	420	357	388	509.2
Odonata	6	8	7	9	7	7.4	Trichoptera	71	608	170	175	279	260.6
Ephemeroptera	2	2	2	2	2	2.0	Odonata	31	546	101	398	115	238.2
PLASTIC							PLASTIC						
DIPTERA	34	33	35	41	41	36.8	DIPTERA	2224	1544	1192	1666	1974	1720.0
Trichoptera	11	10	12	10	12	11.0	Trichoptera	113	39	88	127	260	125.4
Odonata	10	7	7	11	10	9.0	Odonata	118	38	58	138	66	83.6
SKIDWAY							SKIDWAY						
DIPTERA	42	26	31	32	38	33.8	DIPTERA	6040	4451.4	3176	2944	5821	4486.5
Trichoptera	13	10	10	13	11	11.4	Trichoptera	496	156	203	241	266	272.4
Odonata	11	8	11	10	10	10.0	Odonata	264	179	138	139	72	158.4
WESTWARD							WESTWARD						
DIPTERA	46	40	41	37	49	42.6	DIPTERA	1155	3728.2	5104	4733	1478	3239.6
Trichoptera	8	11	10	6	9	8.8	Ephemeroptera	417	774	684	104	209	437.6
Oligochaeta	6	8	5	5	6	6.0	Oligochaeta	89	216	483	191	53	206.4
Ephemeroptera	5	5	3	5	4	4.4	Haplotaxida	41	190	432	159	38	172.0
Haplotaxida	4	5	3	2	3	3.4	Trichoptera	38	41	119	26	83	61.4
Lumbriculida	2	2	1	2	2	1.8	Lumbriculida	48	19	45	12	12	27.2
Tubificida		1	1	1	1	1.0	Tubificida	0	7	6	20	3	9.0
YOUNG							YOUNG						
DIPTERA	35	34	33	50	41	38.6	DIPTERA	649	2646.5	1014	1072	449	1166.1
Trichoptera	9	12	8	13	12	10.8	Ephemeroptera	118	270	38	265	82	154.6
Ephemeroptera	7	8	5	7	5	6.4	Gastropoda	96	156	97	187	151	137.4
Odonata	7	6	5	6	8	6.4	Mesogastrophora	74	132	90	171	146	122.6
Gastropoda	5	6	4	5	4	4.8	Odonata	67	200	85	168	93	122.6
Basomatophora	3	4	2	3	2	2.8	Trichoptera	52	128	70	197	81	105.6
Mesogastrophora	2	2	2	2	2	2.0	Basomatophora	22	24	7	16	5	14.8

Table 13. Listing of the taxa found only in one lake throughout the five-year study period.

TAXA	DESCRIPTION	LAKE	ABUNDANCE/YEAR
Acanthocephala	thought to be related to parasitic Rotifera (Clement 1985)		
Genus indet. F92		CROSSON	2 / 1992
Oligochaeta	AQUATIC EARTHWORMS best known for their injestion of sediments from the littoral and profundal zones		
Rhyacodrilus	- found in situations of low organic matter	WESTWARD	8 / 1992
Tasserkidrilus		HARP	1 / 1989
Isopoda	AQUATIC SOW BUGS		
Caecidotea	(Asellus) alternate name	SKIDWAY	115 / 1988, 24 / 1989, 8 / 1990
Amphipoda	SCUDS, SIDESWIMMERS		
Diporeia		HAMER	67 / 1989
Ostracoda	MUSSEL and SEED SHRIMPS		
Darwinula	only N American freshwater genus in Suborder Metcopina, no males in this genus	BLUE CHALK	4 / 1992
Hydracarina	WATER MITES		
Atractides	parasites 10 to 20 / host (one found, therefore not significant)	CROSSON	1 / 1992
Frontipoda	usual host Plecoptera, Odonata, Diptera, and Hemiptera	DELANO	1 / 1992
Midiopsis		HARP	1 / 1990, 1 / 1991
Tardigrada	WATER BEARS		
Dactylobiotus		HARP	16 / 1990
Ephemeroptera	MAYFLIES		
Cleon		YOUNG	1 / 1988
Odonata	DRAGONFLIES, DAMSELFLIES		
Dorocordulia	dragonfly	HAMER	1 / 1992
Plecoptera	STONEFLIES		
Nemoura	rare sp in northern Rocky mtns (NEMOURIDAE)	YOUNG	1 / 1988, 1 / 1991
Soyedina	eastern and western , uncommon (NEMOURIDAE)	WESTWARD	2 / 1988
Hemiptera	TRUE BUGS		
Belostoma	giant water bugs. Adults fly in autum to deep lentic habitats to overwinter	PLASTIC	2 / 1991

Table 13 cont'd. Listing of the taxa found only in one lake throughout the five-year study period.

TAXA	DESCRIPTION	LAKE	ABUNDANCE/YEAR
Neuroptera	SPONGILLA FLIES		
Climacia	Sisyridae, only aquatic family	HAMER	1 / 1989, 1 / 1990, 1 / 1991, 2 / 1992
Trichoptera	CADDIS FLIES		
Diplectrona	widely scattered species	HARP	1 / 1989
Coleoptera	BEETLES		
Phytosus		CROSSON	1 / 1989
Tropisternus	common water scavenger beetles, good swimmers Adults fly to larger lentic habitats to overwinter	SKIDWAY	2 / 1988
DIPTERA	FLIES, MOSQUITOES, MIDGES		
Diptera Ceratopogonidae	FLIES		
Brachypogon	(soldier, horseflies, snipe ?)	HAMER	1 / 1991
Chironomidae	TRUE MIDGES		
Subfam.-Tanypodinae	bottom dwellers, mud browsers		
Paramerina		HARP	1 / 1991, 1 / 1992
Tanypus		HAMER	13 / 1991, 11 / 1992
Trissopelopia		YOUNG	1 / 1991
Subfam.-Prodiamesinae			
Prodiamesa		YOUNG	2 / 1991, 1 / 1992
Subfam.-Orthocladiinae			
Oliveridia		HARP	1 / 1991
Rheocricotopus		CLEAR	14 / 1989
Stictocladius		WESTWARD	1 / 1992
Synorthocladius	commensal on mayflies and stoneflies	HARP	1 / 1989
Thienemanniella		WESTWARD	12 / 1989, 1 / 1990
Subfam.-Chironominae			
Tribe-Chironomini			
Lipiniella		BLUE CHALK	2 / 1991
Tribe-Tanytarsini			
Zavrelia		WESTWARD	1 / 1988
DIPTERA: Tabanidae	HORSEFLIES and DEERFLIES		
Tabanus	larvae devour snails, Oligochaetes and insect larvae	SKIDWAY	1 / 1988
DIPTERA: Tipulidae	CRANE FLIES		
Dactylolabis	occupy algal scum with percolating water	HAMER	1 / 1991
Dicranota	occupy rich mud at edges of bodies of water	WESTWARD	1 / 1992
DIPTERA: Misc.			
Cecidomyiidae		CROSSON	2 / 1991
Empididae	other genera, leaf miners in Aquatic plants	WESTWARD	1 / 1992
Gastropoda	SNAILS, LIPETS		
Gyraulus	snails	BLUE CHALK	1 / 1988, 15 / 1990

Table 14. Listing of the taxa common to all 12 lakes throughout the five-year study period.

TAXA

- **Oligochaeta (aquatic earthworms)**
  - Enchytraeidae (aquatic or terrestrial)
  - Lumbriculus (aquatic)
  - Tubificidae (aquatic)
- **Hirudinea (leeches)**
  - Helobdella (5 - 20 mm, brown in colour)
- **Amphipoda (Scuds, Sideswimmers)**
  - Crangonyx (genera largest in number of species)
  - Hyalella (4 - 8mm, widely distributed)
- **Ephemeroptera (Mayflies)**
  - Eurylophella (aquatic nymphs)
  - Leptophlebia (aquatic nymphs)
- **Odonata (Dragonflies, Damselflies)**
  - Cordulia (dragonfly nymph)
  - Enallagma (damselfly nymph)
  - Gomphus (dragonfly nymph)
  - Libellula (dragonfly nymph)
- **Trichoptera (Caddis flies)**
  - Agrypnia (aquatic larva)
  - Nectopsyche (aquatic larva)
  - Oecetis (aquatic larva)
  - Polycentropus (aquatic larva)
  - Ptilostomis (aquatic larva)
  - Pycnopsyche (aquatic larva)

TAXA

- **DIPTERA TOTAL (Flies, Mosquitoes, Midges)**
- **Diptera Ceratopogonidae (biting midges)**
  - Bezzia
  - Probezzia
- **Chironomidae (nonbiting midges)**
- **Sub-family - Tanypodinae** (bottom dwellers, mud browsers)
  - Ablabesmyia
  - Conchapelopia
  - Larsia
  - Procladius
- **Sub-family - Orthocladiinae**
  - Parakiefferiella
  - Psectrocladius
  - Zalutschia
- **Sub-family - Chironominae**
- **Tribe - Chironomini**
  - Cryptochironomus
  - Dicrotendipes
  - Endochironomus
  - Glyptotendipes
  - Microtendipes
  - Nilothauma
  - Paratendipes
  - Phaenopsectra
  - Polypedilum
  - Pseudochironomus
  - Stenochironomus
  - Stictochironomus
  - Tribelos
- **Tribe-Tanytarsini**
  - Cladotanytarsus
  - Paratanytarsus
  - Tanytarsus/Micropsectra
- **Gastropoda (Snails,and Limpets)**
  - Ferrissia (limpets)
- **Pelecypoda (Clams and Mussels)**
  - Pisidium (fingernail clams)

Table 15: Pearson product-moment correlations between the various water-chemistry parameters and the 7 biological metrics over the five-year study. Correlations larger than +/- 0.576 are individually significant at P<0.05 (i.e., the shaded values).

BIOLOGICAL			WATER CHEMISTRY PARAMETERS																		
METRIC		YEAR	ALKT	ALKTI	AL	CA	CL	COND25	DIC	DOC	FE	K	MG	MN	NA	NH4	NO3	TKN	pH	SO4	TP
# OF	GENERA	88	0.430	0.434	-0.043	0.415	0.159	0.293	0.405	0.204	-0.098	0.327	0.214	-0.106	0.257	0.101	0.266	0.207	0.374	-0.300	0.204
# OF	GENERA	89	0.534	0.545	0.230	0.794	0.431	0.822	0.778	0.506	0.442	0.665	0.883	0.210	0.736	-0.091	0.596	0.458	0.343	0.603	0.616
# OF	GENERA	90	0.287	0.316	0.079	0.749	0.351	0.673	0.563	0.436	0.453	0.215	0.707	0.290	0.359	-0.405	-0.177	0.313	0.351	0.755	0.314
# OF	GENERA	91	0.296	0.317	0.480	0.610	0.516	0.572	0.401	0.641	0.372	0.543	0.408	-0.129	0.554	-0.340	0.244	0.596	0.139	0.204	0.540
# OF	GENERA	92	0.263	0.291	0.393	0.703	0.444	0.644	0.471	0.601	0.607	0.313	0.545	-0.040	0.479	-0.070	0.534	0.520	0.182	0.332	0.643
# OF	INDIVIDUALS	88	-0.324	-0.311	0.596	-0.117	0.488	-0.116	-0.372	0.503	-0.333	0.098	-0.387	-0.693	-0.003	0.556	-0.109	0.573	-0.491	-0.499	0.347
# OF	INDIVIDUALS	89	-0.057	-0.047	0.411	0.025	-0.021	0.076	0.145	0.254	0.105	0.366	-0.077	0.391	-0.002	0.337	0.639	0.310	-0.314	-0.037	0.068
# OF	INDIVIDUALS	90	-0.077	-0.067	-0.078	-0.021	-0.037	-0.116	-0.021	-0.108	0.032	-0.105	-0.104	0.295	-0.244	-0.083	0.096	-0.141	0.079	-0.064	-0.252
# OF	INDIVIDUALS	91	-0.070	-0.055	0.396	-0.104	0.174	-0.128	0.070	0.280	0.433	0.264	-0.238	0.496	-0.031	0.417	0.300	0.431	-0.144	-0.486	0.253
# OF	INDIVIDUALS	92	-0.420	-0.394	0.716	-0.118	0.157	-0.150	-0.282	0.475	0.527	-0.054	-0.328	-0.250	-0.063	0.454	-0.019	0.575	-0.574	-0.202	0.504
H'	DIVERSITY	88	-0.564	-0.575	-0.191	-0.764	-0.454	-0.739	-0.553	-0.515	-0.362	-0.836	-0.596	-0.068	-0.666	0.092	-0.275	-0.437	-0.432	-0.266	-0.070
H'	DIVERSITY	89	-0.342	-0.340	0.329	-0.156	0.072	-0.078	-0.078	0.232	0.501	-0.334	0.020	0.202	-0.042	0.167	0.427	0.271	-0.253	0.095	0.255
H'	DIVERSITY	90	-0.176	-0.177	0.021	-0.204	0.046	-0.190	-0.189	-0.022	-0.169	-0.150	-0.199	0.346	-0.110	0.214	0.456	-0.128	-0.110	-0.322	-0.317
H'	DIVERSITY	91	-0.276	-0.268	0.346	0.013	0.405	0.131	-0.179	0.223	0.085	-0.157	0.068	-0.337	0.314	-0.074	-0.208	0.121	-0.335	0.278	0.095
H'	DIVERSITY	92	-0.623	-0.622	0.397	-0.349	0.034	-0.338	-0.385	0.180	0.414	-0.578	-0.336	0.426	-0.327	0.528	-0.184	0.152	-0.508	-0.084	-0.238
CAI	LOG(X+1)	88	0.483	0.489	0.169	0.624	0.222	0.498	0.454	0.382	0.316	0.390	0.400	0.522	0.255	0.262	-0.095	0.386	0.429	0.104	0.476
CAI	LOG(X+1)	89	0.421	0.427	0.059	0.541	0.071	0.444	0.630	0.233	0.253	0.415	0.411	0.455	0.171	0.204	0.153	0.278	0.264	0.222	0.316
CAI	LOG(X+1)	90	0.516	0.524	0.043	0.559	0.058	0.399	0.622	0.303	0.345	0.386	0.415	0.446	0.175	0.082	-0.073	0.373	0.531	0.014	0.359
CAI	LOG(X+1)	91	0.588	0.594	0.006	0.558	0.059	0.357	0.607	0.321	0.340	0.366	0.384	0.328	0.141	-0.141	0.095	0.393	0.581	-0.133	0.417
CAI	LOG(X+1)	92	0.534	0.556	0.106	0.527	0.031	0.288	0.537	0.338	0.384	0.362	0.321	0.106	0.069	0.181	0.019	0.393	0.493	-0.203	0.524
CAII	LOG(X+1)	88	-0.250	-0.264	-0.289	-0.527	-0.486	-0.560	-0.156	-0.432	0.283	-0.724	-0.333	0.463	-0.567	0.116	-0.104	-0.333	-0.057	-0.329	-0.210
CAII	LOG(X+1)	89	-0.247	-0.263	-0.253	-0.489	-0.419	-0.550	-0.285	-0.373	-0.005	-0.585	-0.417	0.332	-0.561	0.062	-0.133	-0.267	-0.014	-0.475	-0.133
CAII	LOG(X+1)	90	-0.271	-0.283	-0.273	-0.567	-0.515	-0.630	-0.297	-0.421	-0.037	-0.640	-0.468	0.317	-0.595	0.189	-0.036	-0.343	-0.073	-0.491	-0.179
CAII	LOG(X+1)	91	-0.149	-0.161	-0.437	-0.535	-0.488	-0.571	-0.212	-0.542	-0.107	-0.475	-0.409	0.463	-0.509	0.525	-0.050	-0.362	0.020	-0.477	-0.384
CAII	LOG(X+1)	92	-0.325	-0.356	-0.351	-0.629	-0.606	-0.660	-0.341	-0.516	-0.184	-0.730	-0.471	0.216	-0.636	0.065	-0.314	-0.431	-0.169	-0.189	-0.419
CAI	P/A	88	0.433	0.436	0.177	0.558	0.179	0.426	0.400	0.367	0.269	0.347	0.329	0.572	0.171	0.317	-0.159	0.376	0.384	0.055	0.427
CAI	P/A	89	0.380	0.384	0.029	0.467	-0.014	0.359	0.551	0.177	0.205	0.328	0.328	0.471	0.080	0.184	0.062	0.231	0.237	0.169	0.282
CAI	P/A	90	0.516	0.524	0.043	0.559	0.058	0.399	0.622	0.303	0.345	0.386	0.415	0.446	0.175	0.082	-0.073	0.373	0.531	0.014	0.359
CAI	P/A	91	0.515	0.522	0.014	0.491	-0.023	0.265	0.522	0.305	0.356	0.237	0.307	0.290	0.032	-0.114	0.002	0.378	0.516	-0.154	0.432
CAI	P/A	92	0.424	0.445	0.109	0.414	-0.104	0.152	0.416	0.300	0.379	0.192	0.227	0.167	-0.094	0.225	-0.115	0.363	0.415	-0.204	0.462
CAII	P/A	88	-0.332	-0.344	-0.173	-0.464	-0.378	-0.464	-0.143	-0.349	0.382	-0.794	-0.226	0.546	-0.589	0.200	-0.176	-0.248	-0.159	-0.115	-0.230
CAII	P/A	89	-0.434	-0.450	-0.158	-0.517	-0.386	-0.584	-0.401	-0.337	0.075	-0.724	-0.471	0.314	-0.665	0.172	-0.333	-0.239	-0.139	-0.328	-0.224
CAII	P/A	90	-0.271	-0.283	-0.273	-0.567	-0.515	-0.630	-0.297	-0.421	-0.037	-0.640	-0.468	0.317	-0.595	0.189	-0.036	-0.343	-0.073	-0.491	-0.179
CAII	P/A	91	-0.375	-0.385	-0.231	-0.535	-0.440	-0.582	-0.356	-0.392	0.052	-0.731	-0.400	0.330	-0.604	0.459	-0.285	-0.301	-0.207	-0.233	-0.297
CAII	P/A	92	-0.521	-0.543	-0.110	-0.694	-0.535	-0.729	-0.499	-0.360	-0.041	-0.858	-0.572	0.251	-0.698	0.230	-0.407	-0.299	-0.389	-0.239	-0.432

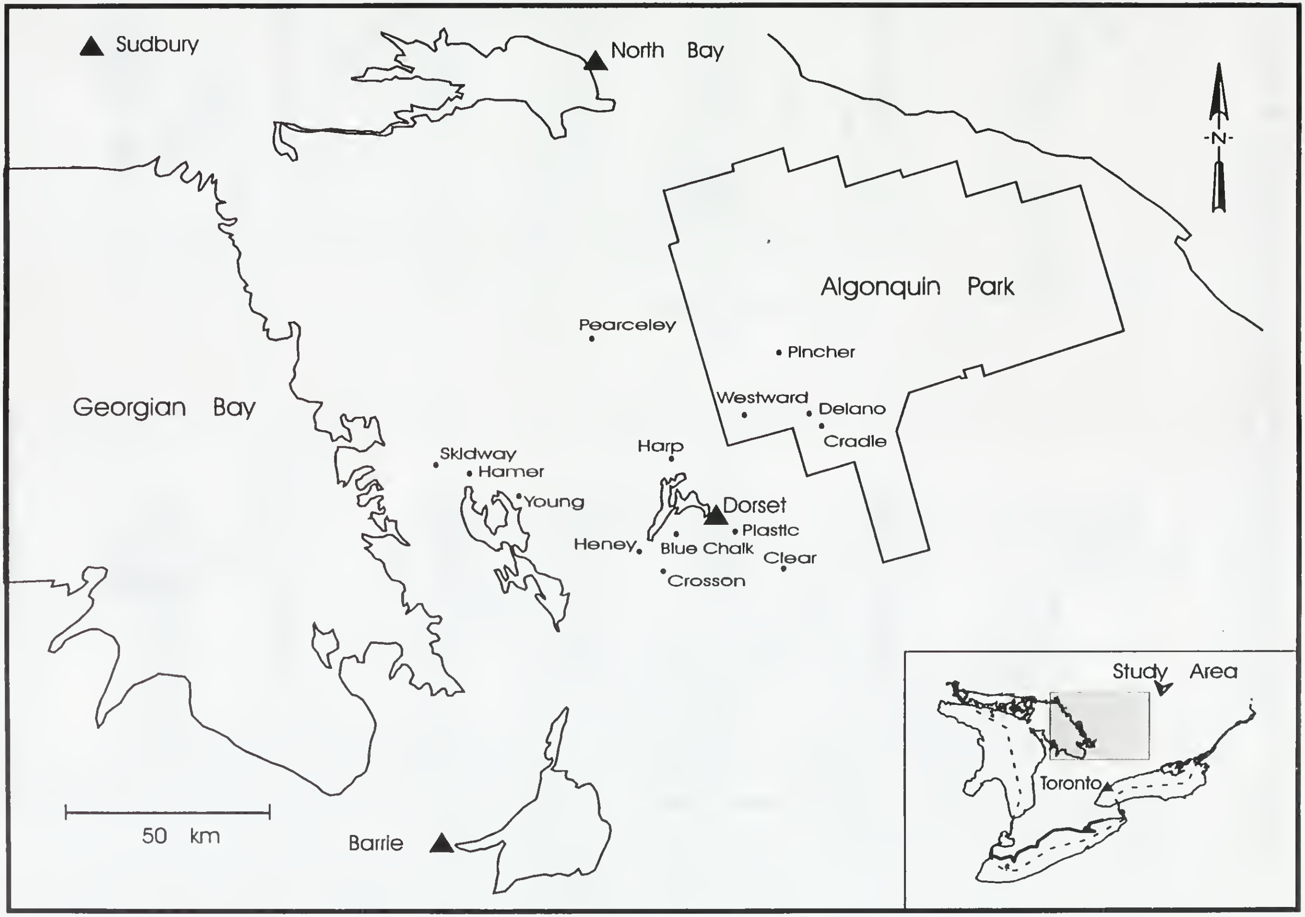

Sudbury
North Bay
N
Algonquin Park
Pearceley
Pincher
Westward
Delano
Cradle
Georgian Bay
Harp
Skidway
Hamer
Young
Dorset
Plastic
Heney
Blue Chalk
Clear
Crosson
Study Area
Toronto
50 km
Barrie

Figure 2. Z-score plots comparing taxonomic richness and abundance for 12 lakes surveyed in the fall 1988 - 1992.

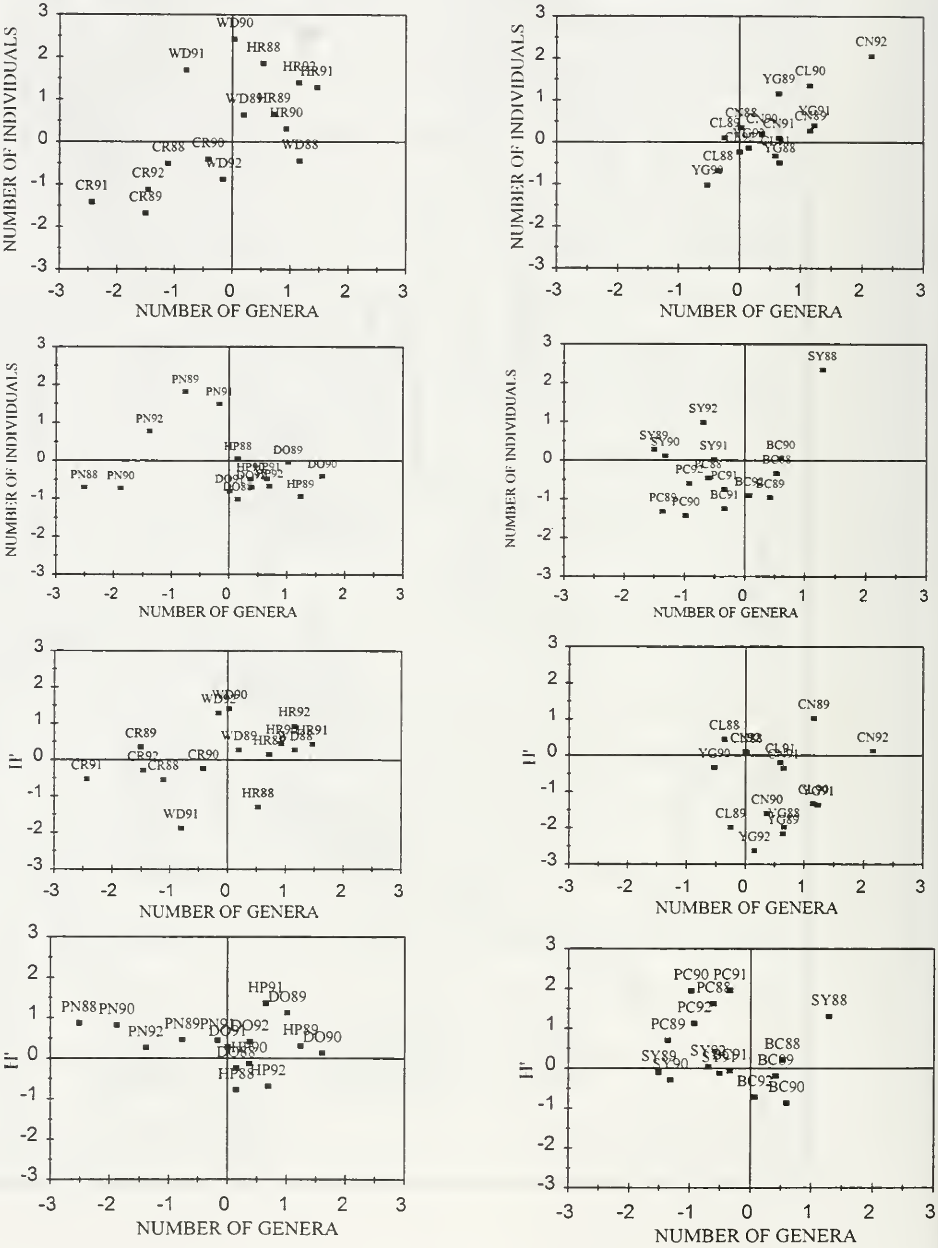


Figure 2. Cont'd Z-score plots comparing taxonomic richness and abundance for 12 lakes surveyed in the fall 1988 - 1992.

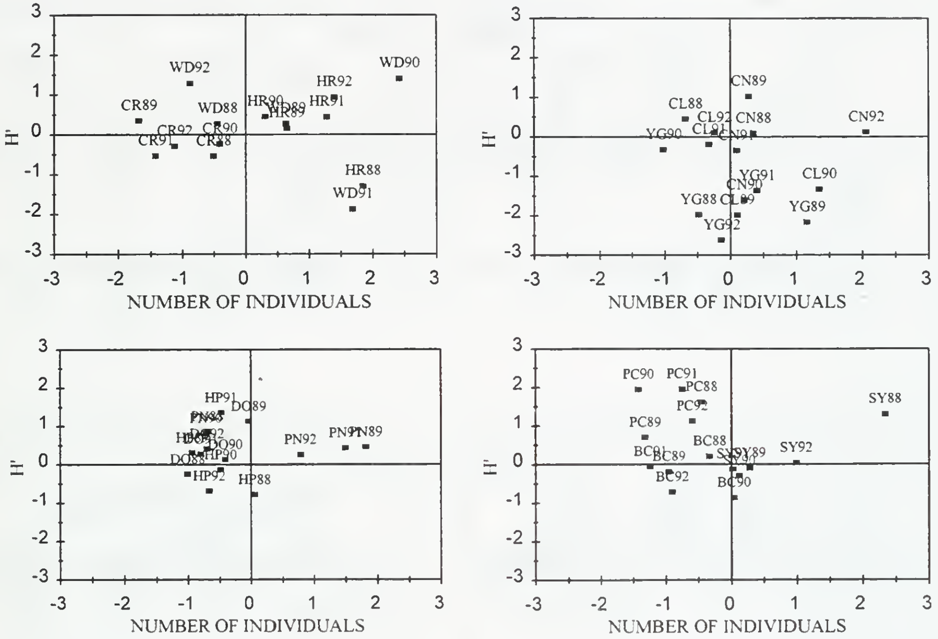


Figure3: CA Ordination of the Log-Transformed Abundance Data

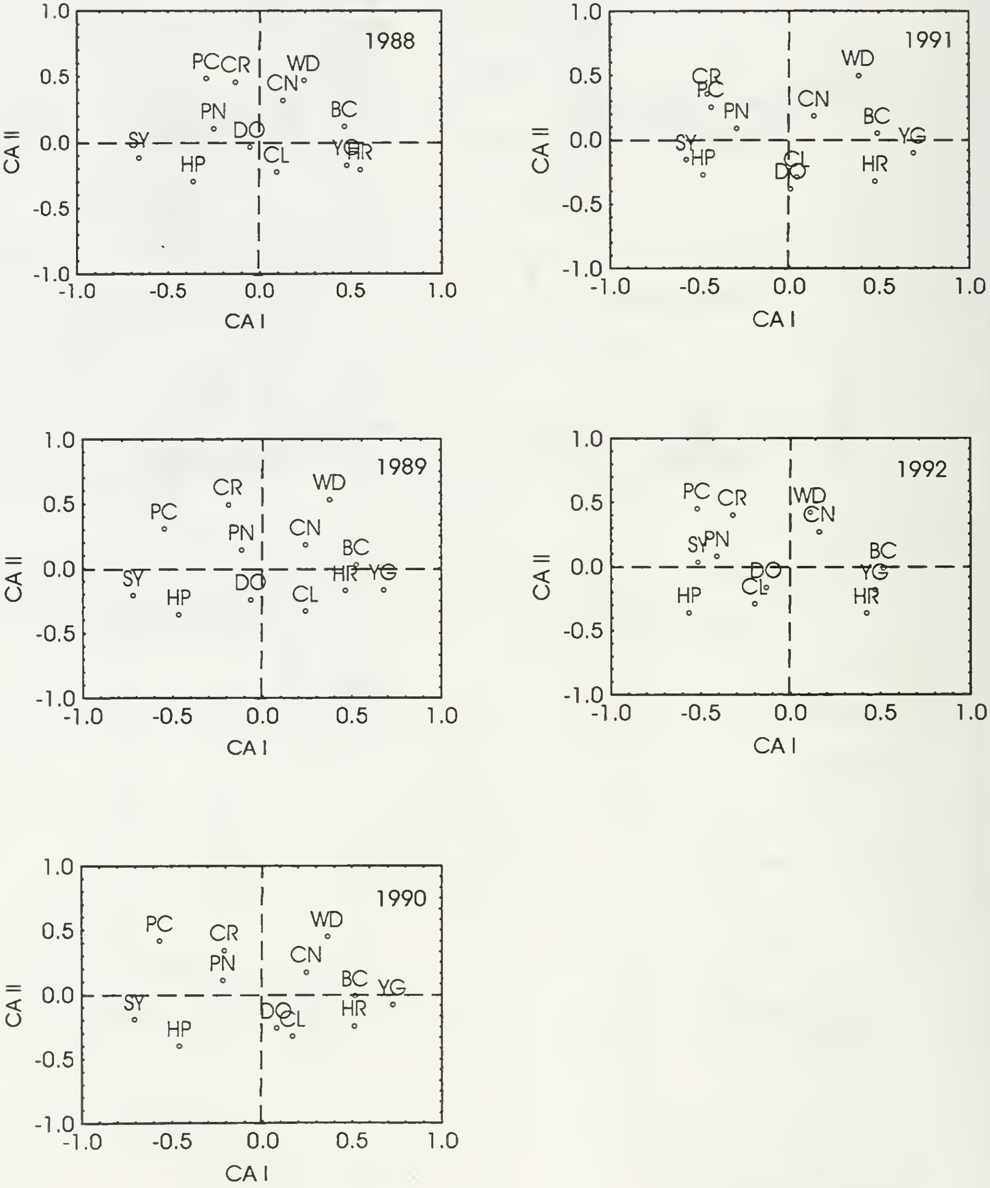
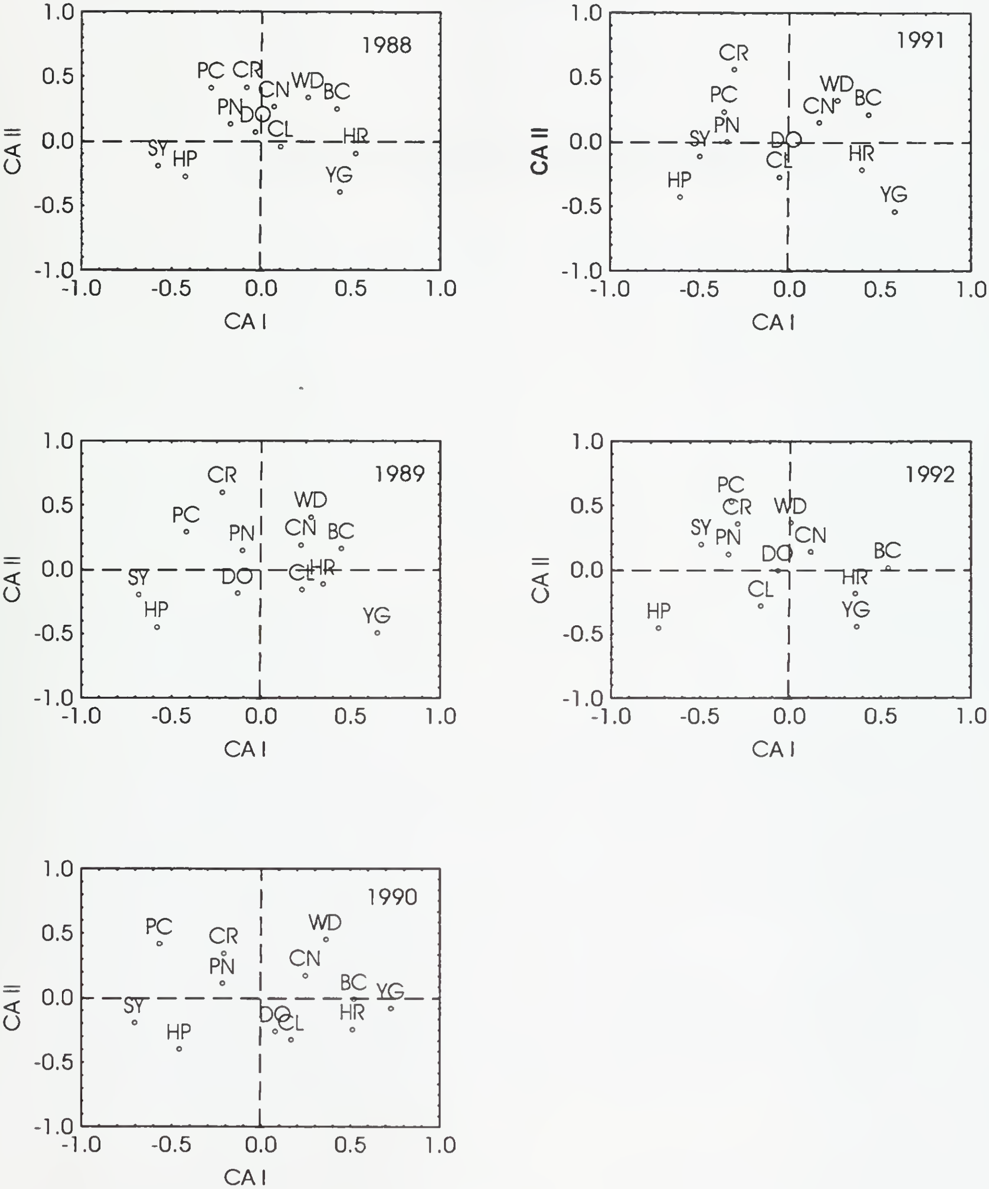


Figure 4: CA Ordination of the Macroinvertebrate Presence/Absence Data



APPENDIX 1

LRTAP RATIONALE AND SAMPLING PROTOCOLS

INTRODUCTION

As part of the overall biological effects monitoring program, the periodic survey of lake benthos is intended to give a reliable estimate of community structure for the common, but sensitive, benthic and semi-benthic macroinvertebrates and to determine the response through time of these communities to changing environmental conditions. The emphasis has been placed on sampling three major groups: Ephemeroptera, Trichoptera and Crustacea, partly due to the established sensitivity of these groups to a variety of contaminants and partly because these groups are important links in the food chain, are widely represented across the country and easily sampled by a variety of techniques.

Four principal sampling activities are used to characterize the benthic fauna of each lake. First, representative segments of shoreline and the adjacent shallow littoral areas are sampled with sweep nets and by hand to collect Ephemeroptera, Trichoptera, Odonata, Amphipoda, Gastropoda and other miscellaneous shallow-water forms. Second, dredge samples are taken from the deeper portions of the lake to collect Amphipoda, Mollusca and Insecta from the sub-littoral. Third, baited wire traps, set out overnight, are used to capture Decapoda and Hirudinea. And fourth, taxa such as *Mysis* or *Chaoborus*, which are benthic during the day, but planktonic at night, are captured by a series of night time, vertical net tows.

The methods presented here have been tested at the Experimental Lakes Area, northwestern Ontario and are thought to be generally applicable to most lacustrine habitats. Following an initial year of testing and evaluation, revisions or additions to the protocol may be necessary

Lake Selection - The "lake benthos" portion of the protocol is based on the assumption that lakes have been selected for their general usefulness in biomonitoring, according to the criteria agreed upon at the May, 1986 Winnipeg Workshop.

Survey Timing - It is difficult to base the characterization of any habitat on the presence or absence of the early life stages of most benthic invertebrates. Young are difficult to collect because they often choose refuges that are hard to sample effectively. Relative to the adult forms, young are small, fragile and often escape all but the finest mesh samplers, or are damaged beyond recognition. In addition, young are often morphologically different from the adults and generally of little use to the taxonomists. To ensure maximum benefit from the work, therefore, it is important that the benthic surveys be conducted at a time of year when the maximum number of species are present in the adult form or late larval stages.

For crustacean invertebrates, this time is in the spring or early summer. For the Trichoptera, Ephemeroptera and Odonata, adult insect emergence usually begins within a month or two after ice-out and continues throughout the summer, depending on the species present. While the taxonomy of insects is primarily based on the adults, the latter three groups are more easily sampled in their aquatic forms as larvae or nymphs and in most cases are taxonomically distinct enough to provide genus or species level identifications. Larval identifications of the Chironomidae or the Chaoboridae are more difficult without associated adult material. However, the period of chironomid emergence is protracted, due to the variety of species present in most habitats, so only a few adult forms could be sampled during a "one short" survey. Adult Diptera should, therefore, be overlooked and preference given to larval sampling. As with the other groups, the best time to do this is in the spring, prior to the major period of adult insect emergence. The resultant loss of taxonomic information for the chironomids and chaoborids is probably not critical since these insects generally appear to be more resistant to various forms of pollution than other benthic taxa.

Molluscs and leeches can be effectively sampled at any time of the year, but in the case of decapoda crustaceans, there are some advantages to sampling either in the spring or late fall. Crayfish overwinter in the intermoult stage and females lay eggs in the spring, so at this time of year collections can be used to evaluate the maximum degree of exoskeleton hardening and breeding success. By late fall young-of-the-year crayfish can be captured (though sometimes with difficulty) to determine recruitment success.

Although the optimum time of year to sample each system will ultimately depend upon a consideration of the various life histories of its fauna, it seems that, as a general rule, it is best to sample in the spring.

Sampling Methods

(a) **Optimizing Sampling Effort** - The sampling protocol outlined below is intended to be used as a guideline. The methodologies have been chosen for their general usefulness, but they are quite specific in their detail. Although it is recognized that they may not be universally applicable, each of the methods should be tried.

The lack of a precise definition of the amount of sampling effort required to yield a representative sample of the fauna in each habitat, is one area of critical weakness in the protocol. This is particularly true of the section on shoreline and shallow littoral sampling, where sampling effort has been defined as the amount of time spent performing each sampling activity. The shoreline and shallow water areas of most lakes are the most productive and diverse habitats and often the most difficult to sample effectively. This area also contains the greatest number of sensitive species, largely because the animals are exposed to the highest fluxes of pollutants entering the lake. It is important, therefore, to take great care when choosing the sampling sites and to obtain some measure of sampling efficiency.

Gear type, physical conditions of the area and the skill of individual workers are all factors which will affect collecting efficiency. Two procedures are recommended for the first year of sampling (and periodically thereafter) to maximize the specimen return and minimize sampling effort:

(i) An experienced biologist should make the decisions about where to sample and how it should be done (assuming that modifications to standard procedures are necessary). The biologist should oversee the sampling operation, train assistants and eventually ensure program continuity from year to year.

(ii) Using the sampling times suggested in the "shore sampling" section of the protocol as a guideline, the biologist should make three separate sets of collections at each site, then subsequently determine an optimum sampling strategy. This optimum should be taken as the sampling time necessary to obtain more than 90% of the maximum number of species found at any location. Similarly, the number of dredge and net tow samples required should also be evaluated.

(b) **Shore and Shallow Littoral Collections**

(i) Purpose - Many important indicator species occupy the shallow littoral habitat. Principally one should expect to collect representatives of the Ephemeroptera, Trichoptera, Odonata, Decapoda, Amphipoda, Diptera and Coleoptera. The goal is to sample as many different areas as possible, but avoid collecting large volumes of the vegetation, mud, allochthonous material, rocks and gravel that characterize this habitat. In addition, it is important to minimize habitat destruction during the sampling process.

(ii) Site Selection and Documentation - Five shoreline sampling sites should be chosen for each lake. These locations should include both average and extreme habitat types, but should be chosen with a view to a representative characterization of the lake. Preference should be given to areas which afford good cover or great physical, within-site diversity. It is desirable that sites be chosen on both the windward and leeward shores. Areas within the immediate influence of inflowing rivers or streams should be avoided, unless there is some overriding reason to include them, because the faunal composition of these regions is more likely to reflect the characteristics of the inflow than those of the lake.

Site locations should be plotted on a lake map. Each site should then be described in writing and photographed to provide a record for future comparison. thus, any change in the species assemblage at a location can be correlated with long term changes in habitat condition. This baseline record is also useful for monitoring any habitat destruction which may occur as a result of the sampling activities.

Local conditions of wind speed and direction, air and water temperature, water level, cloud cover, precipitation, etc. should also be noted at the time of sampling.

(iii) Sampling Procedures - Sweep net samples are to be taken from the complete range of habitat type in the 0-1 m depth range. With care, the amount of extraneous substrate collected by this method can be minimized. This is desirable because it not only simplifies the task of sorting out the specimens, but also reduces damage to the habitat. During the collecting period the net should be emptied frequently to prevent clogging and loss of specimens. **Suggested sampling time: 10 minutes**.

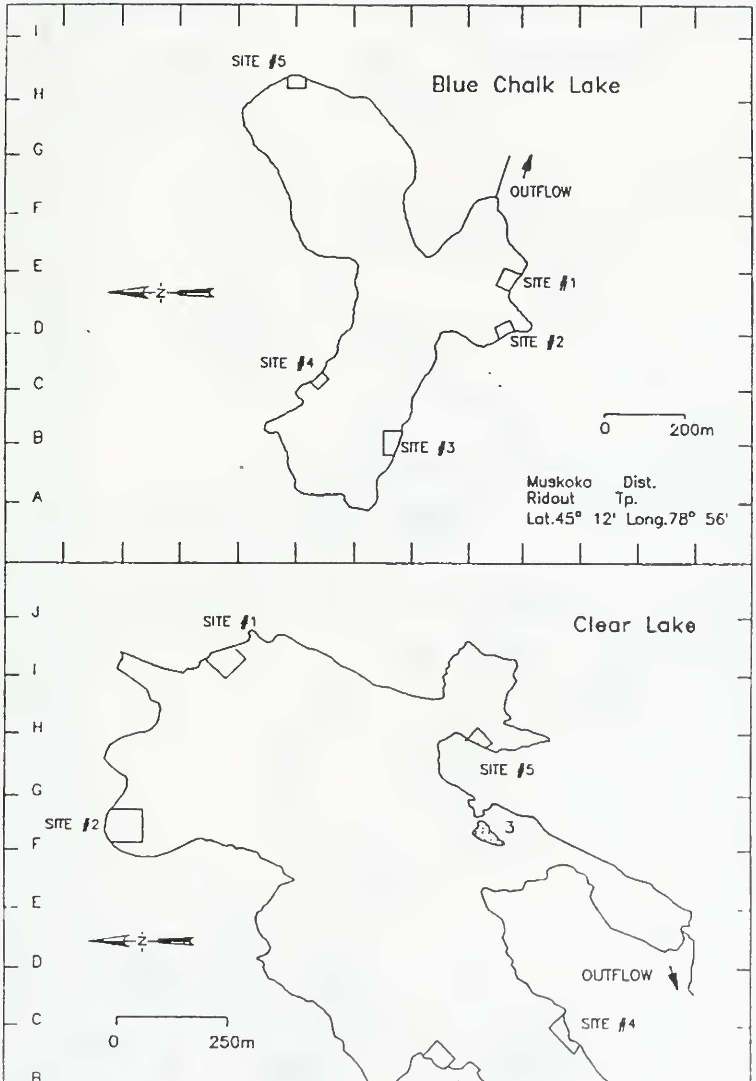
As the final phase of the shoreline sampling, the field worker should spend time making hand collections of invertebrates by turning over rocks, inspecting debris and examining other hard to sample habitats. This is often the most effective way of sampling Trichoptera, Ephemeroptera, Mollusca and other sessile or burrowing animals. Specimens (other than leeches) should be preserved as they are collected. Note that leeches contract when preserved, thereby obscuring their taxonomically useful features. To prevent this problem it is usually easiest to identify the material live or to narcotize specimens with carbon dioxide (Alka Seltzer tablets, dilute soft drinks, soda water or beer) prior to preserving them. **Suggested sampling time: 15 minutes.**

(iv) Secondary Sample Processing and Specimen Identification - The samples were sieved through 6250 and 1000 μm mesh to separate the coarse detritus and large invertebrates from the finer material. The>1000 μm fraction and any invertebrates retained by the 6250 μm mesh were separately preserved in 70% ethanol. After several weeks the sieve fraction (i.e., >1000 μm fraction) was stained to assist in removing the remaining macroinvertebrates from the debris (i.e., using a mixture of 10 g of Eosin B and 10 g Biebrich Scarlet in one litre of water at a rate of 20 mL of the resultant dye solution per 1 litre of sample). The samples were stained for two days, washed , and then sorted to the lowest practical taxonomic level. In most instances, the taxonomic resolution was to the species level. Bohdan Bilyj (of Biotax, Rexdale, Ont.) Identified all of the invertebrates (Appendix 8). No lab changes were implemented in the fall of 1989 relative to the 1988 procedures.

Specimens should be identified to the species level (where possible) according to the taxonomic keys given in the references listed in Appendix 8, or with the aid of taxonomic experts. Type specimens of all taxa should be archived for future reference.

APPENDIX 2

MAPS OF THE STUDY LAKES


Blue Chalk Lake
SITE #5
OUTFLOW
SITE #1
SITE #2
SITE #4
SITE #3
0 200m
Muskoka Dist.
Ridout Tp.
Lat.45° 12' Long.78° 56'
Clear Lake
SITE #1
SITE #5
SITE #2
3
OUTFLOW
SITE #4
SITE #3
0 250m
Haliburton Co.
Sherborne Tp.
Lat.45° 11' Long.78° 43'
N
A
B
C
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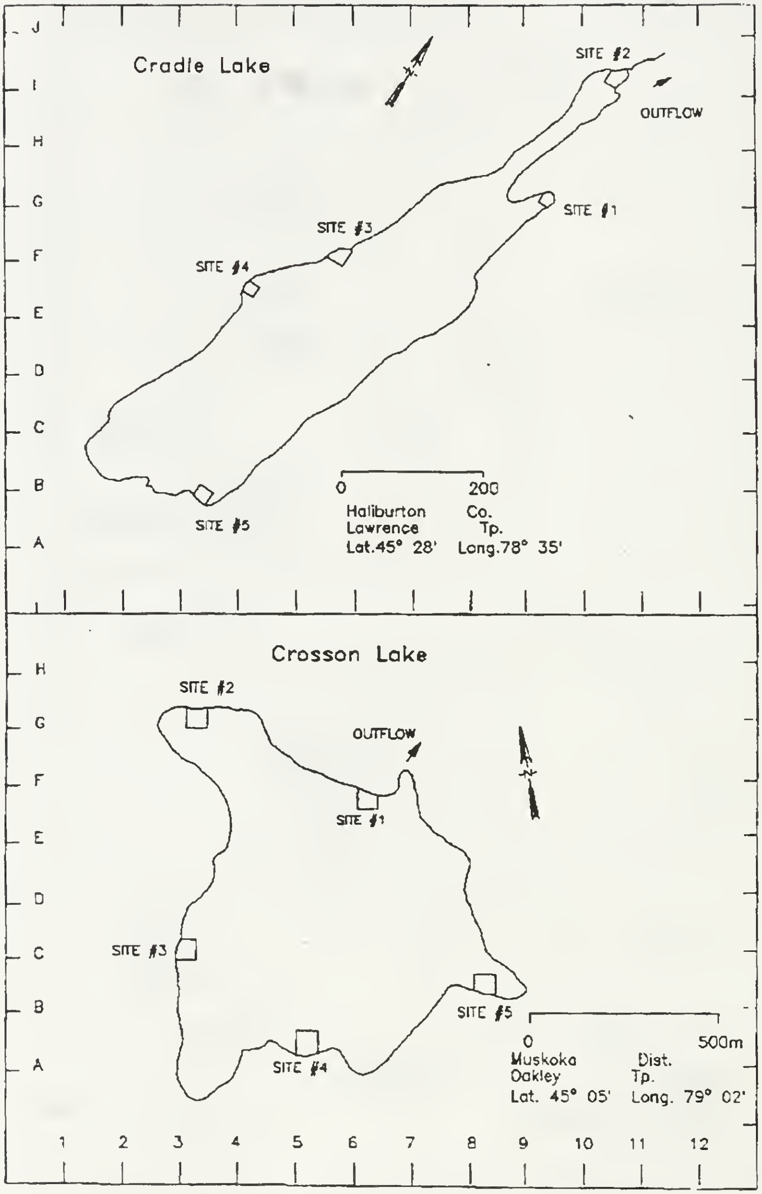
12


Cradle Lake
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
OUTFLOW
0
200
Haliburton Co.
Lawrence Tp.
Lat.45° 28' Long.78° 35'
Crosson Lake
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
OUTFLOW
0
500m
Muskoka Dist.
Oakley Tp.
Lat. 45° 05' Long. 79° 02'
A
B
C
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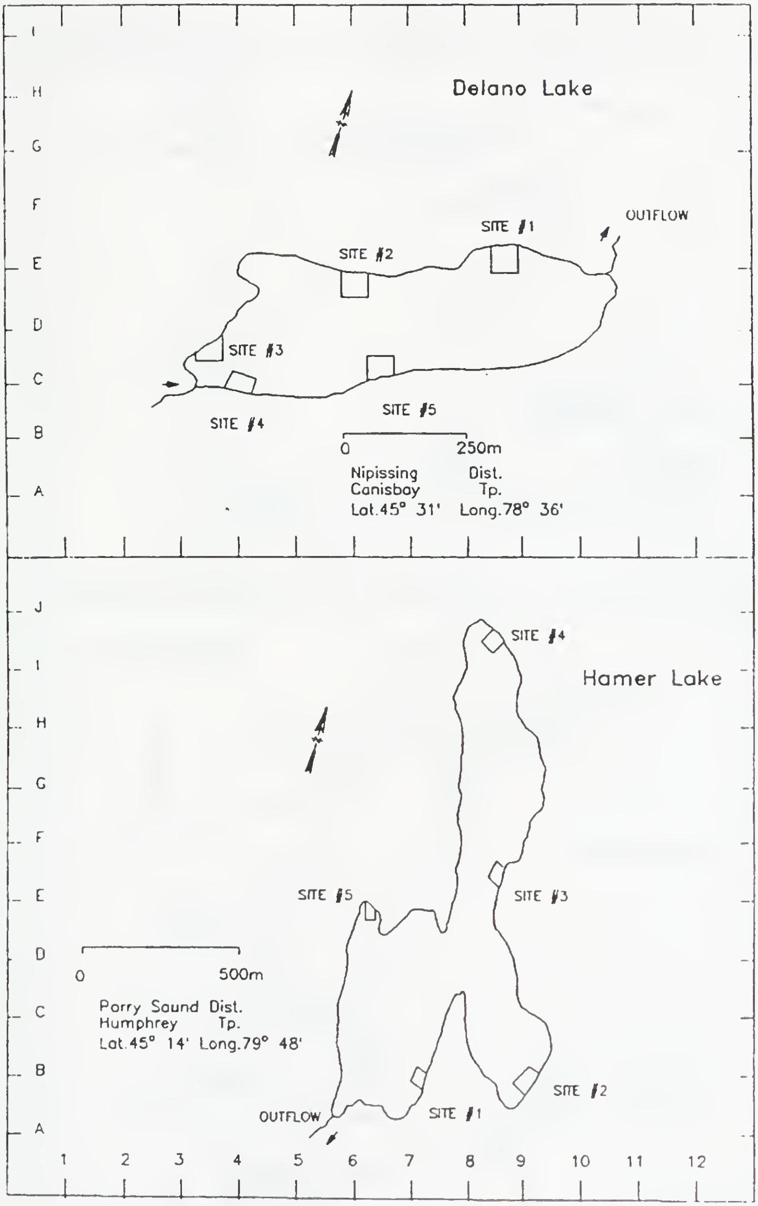
12


Delano Lake
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
OUTFLOW
0
250m
Nipissing Dist.
Canisbay Tp.
Lat.45° 31' Long.78° 36'
I
H
G
F
E
D
C
B
A
Hamer Lake
SITE #4
SITE #3
SITE #5
SITE #2
SITE #1
OUTFLOW
0
500m
Parry Sound Dist.
Humphrey Tp.
Lat.45° 14' Long.79° 48'
J
I
H
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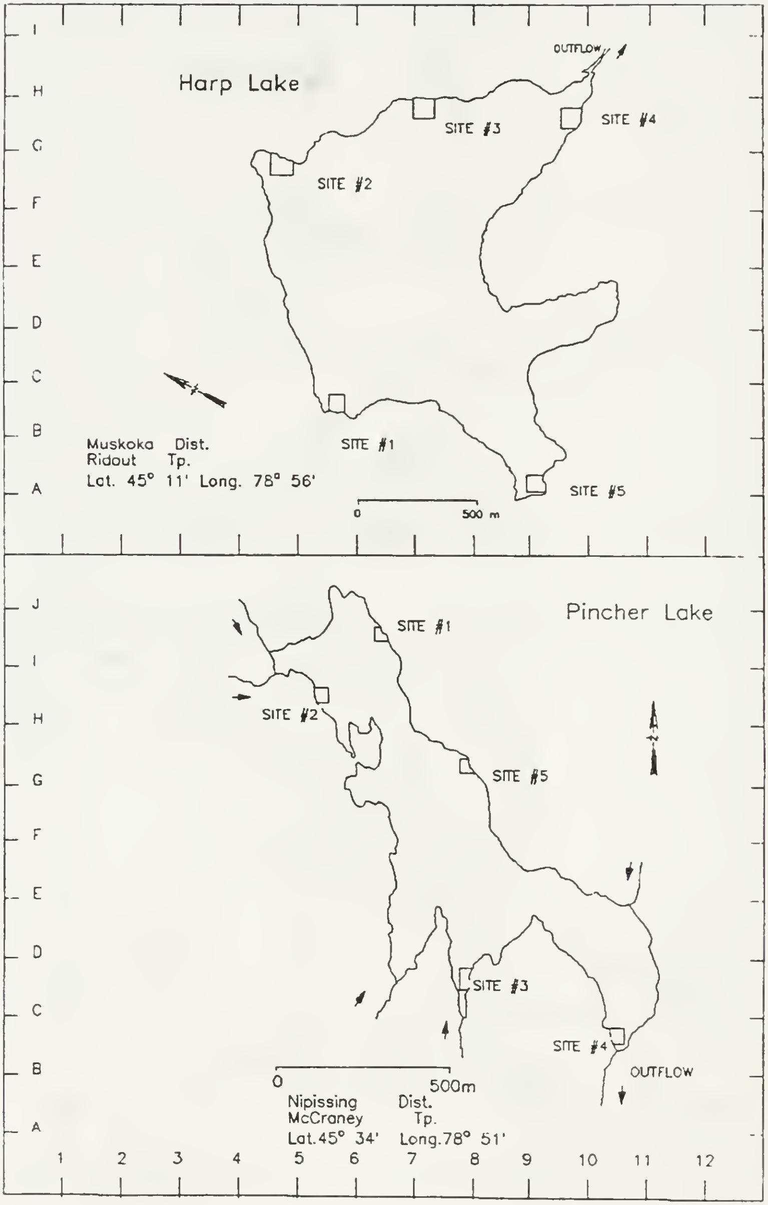
12


Harp Lake
OUTFLOW
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
Muskoka Dist.
Ridout Tp.
Lat. 45° 11' Long. 78° 56'
0
500 m
Pincher Lake
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
OUTFLOW
0
500m
Nipissing Dist.
McCraney Tp.
Lat.45° 34' Long.78° 51'
A
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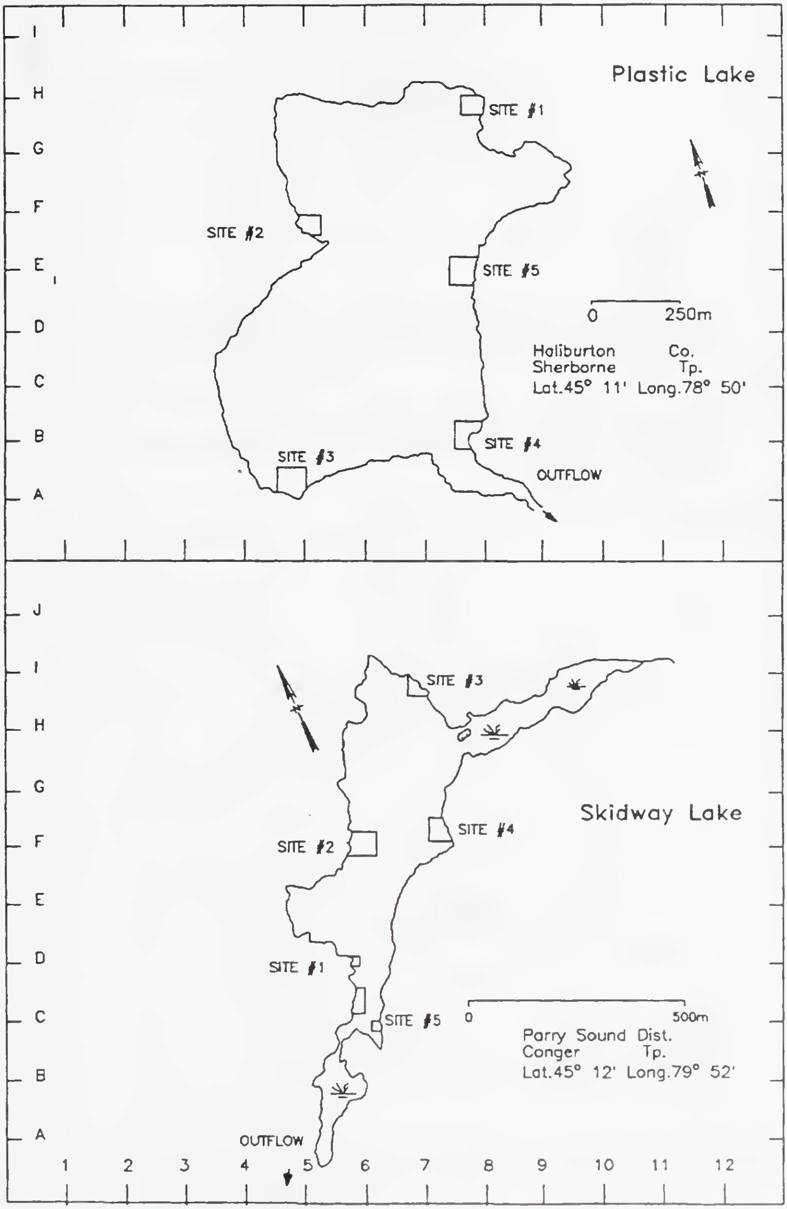
12


Plastic Lake
SITE #1
SITE #2
SITE #5
SITE #3
SITE #4
OUTFLOW
0 250m
Haliburton Co.
Sherborne Tp.
Lat.45° 11' Long.78° 50'
I
H
G
F
E
D
C
B
A
Skidway Lake
SITE #3
SITE #4
SITE #2
SITE #1
SITE #5
OUTFLOW
0 500m
Parry Sound Dist.
Conger Tp.
Lat.45° 12' Long.79° 52'
J
I
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7
8
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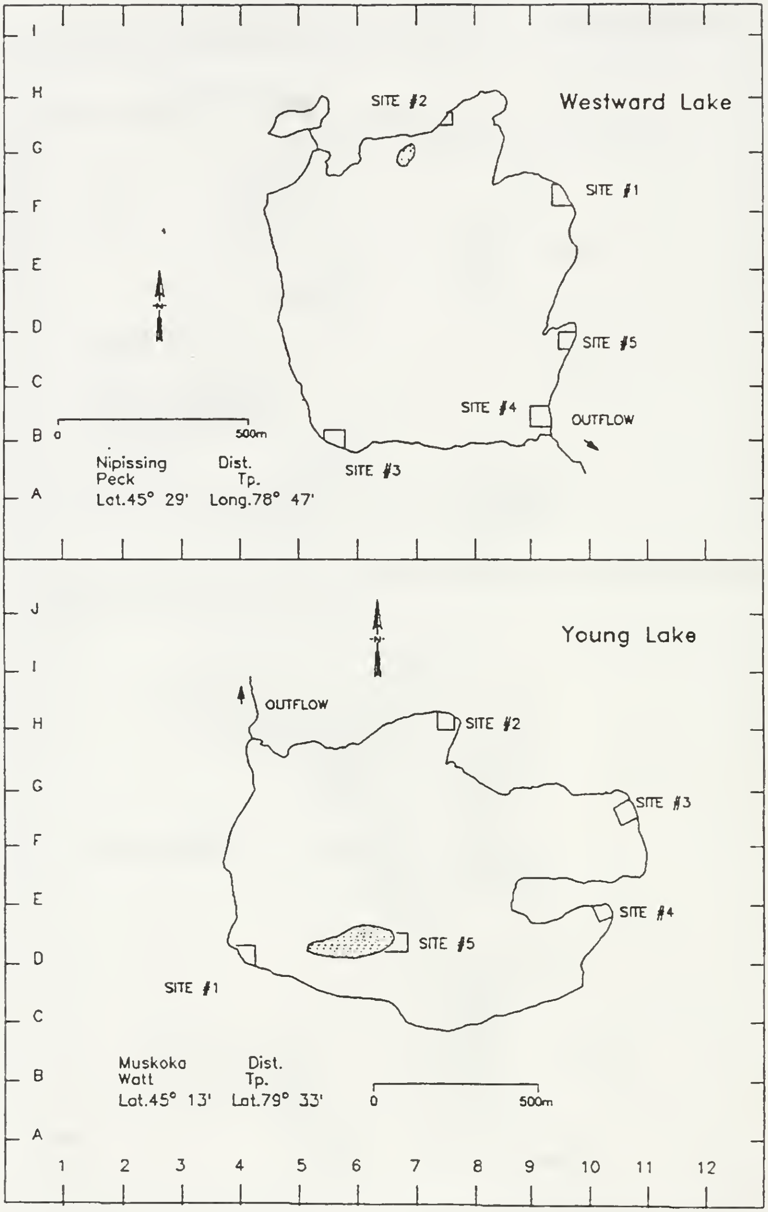
12


Westward Lake
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
OUTFLOW
N
0
500m
Nipissing Dist.
Peck Tp.
Lat.45° 29' Long.78° 47'
I
H
G
F
E
D
C
B
A
Young Lake
OUTFLOW
SITE #1
SITE #2
SITE #3
SITE #4
SITE #5
N
Muskoka Dist.
Watt Tp.
Lat.45° 13' Lat.79° 33'
0
500m
J
I
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APPENDIX 3

DESCRIPTION OF THE CHEMICAL PARAMETERS

ASSOCIATED WITH THE LAKE WATER CHAMISTRY

Appendix 3 Description of chemical parameters.

Parameter	Abbreviation	Description
Alkalinity (μeq·L^{-1})	alkti	Total inflection point alkalinity
Alkalinity (μeq·L^{-1})	alkt	Total fixed point alkalinity to pH 4.5
Alkalinity (mg·L^{-1})	alkt3	Total fixed point alkalinity to pH 3.8
Aluminum (μg·L^{-1})	alut	Total Aluminum unfiltered
Calcium (mg·L^{-1})	caur	Calcium unfiltered reactive
Chloride (mg·L^{-1})	clidur	Chloride unfiltered reactive
Conductivity (μS.cm^{-1})	cond25	Conductivity at 25° C
Dissolved Inorganic Carbon (mg·L^{-1})	DIC	Dissolved Inorganic Carbon
Dissolved Organic Carbon (mg·L^{-1})	DOC	Dissolved Organic Carbon
Iron (μg·L^{-1})	Fe	Total Iron
Potassium (mg·L^{-1})	K	Total Potassium
Magnesium (mg·L^{-1})	Mg	Magnesium
Manganese (μg·L^{-1})	MN	Manganese
Sodium (mg·L^{-1})	NA	Sodium
Ammonium (μg·L^{-1})	NH_4	Ammonium
Nitrate-Nitrite (μg·L^{-1})	NO_3	Nitrate-Nitrite
Total Kjeldahl Nitrogen (μg·L^{-1})	TKN	Total Kjeldahl Nitrogen
pH	pH	pH
Sulphate (mg·L^{-1})	SO_4	Sulphate as SO_4
Total Phosphorus (μg·L^{-1})	TP	Total Phosphorus as P

APPENDIX 4

CHEMICAL PARAMETERS FOR THE 12 STUDY LAKES

OVER THE PERIOD 1988-1992

BLUE CHALK

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	121.04	120.52	123.80	124.16	121.95	122.30	1.626	0.727	124.16	120.52
ALKTI	86.89	85.03	90.20	89.57	89.35	88.21	2.177	0.974	90.20	85.03
ALUT	1.59	4.60	5.53	8.50	3.56	4.76	2.556	1.143	8.50	1.59
CA	2.59	2.59	2.50	2.61	2.53	2.56	0.045	0.020	2.61	2.50
CL	0.37	0.39	0.40	0.41	0.42	0.40	0.018	0.008	0.42	0.37
COND25	28.25	28.50	28.63	27.89	28.67	28.39	0.324	0.145	28.67	27.89
DIC	1.45	1.48	1.54	1.42	1.43	1.46	0.046	0.021	1.54	1.42
DOC	1.63	1.77	1.77	1.81	1.75	1.75	0.067	0.030	1.81	1.63
FE	64.05	52.75	90.78	60.83	47.20	63.12	16.823	7.523	90.78	47.20
K	0.38	0.39	0.38	0.38	0.38	0.38	0.003	0.002	0.39	0.38
MG	0.79	0.76	0.74	0.76	0.74	0.76	0.022	0.010	0.79	0.74
MN	26.41	30.26	38.72	29.70	30.91	31.20	4.546	2.033	38.72	26.41
NA	0.80	0.79	0.79	0.79	0.78	0.79	0.006	0.003	0.80	0.78
NH4	27.67	19.78	20.48	17.75	27.82	22.70	4.715	2.109	27.82	17.75
NO3	31.90	27.13	12.69	15.37	21.75	21.77	7.980	3.569	31.90	12.69
TKN	184.15	193.03	195.06	175.47	177.08	184.96	8.943	3.999	195.06	175.47
pH	6.73	6.62	6.63	6.73	6.71	6.68	0.053	0.024	6.73	6.62
SO4	6.39	6.26	6.21	6.32	6.15	6.27	0.093	0.042	6.39	6.15
TP	5.55	5.69	5.86	5.34	5.70	5.63	0.198	0.088	5.86	5.34

CLEAR

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	40.98	43.79	43.26	45.83	43.23	43.42	1.728	0.773	45.83	40.98
ALKTI	7.11	8.37	8.59	8.42	8.01	8.10	0.590	0.264	8.59	7.11
AL	18.38	21.59	22.53	24.06	33.21	23.95	5.578	2.495	33.21	18.38
CA	2.31	2.38	2.19	2.23	2.13	2.25	0.098	0.044	2.38	2.13
CL	0.41	0.42	0.44	0.43	0.44	0.43	0.014	0.006	0.44	0.41
COND25	25.59	25.67	25.64	24.67	25.33	25.38	0.422	0.189	25.67	24.67
DIC	0.52	0.52	0.74	0.53	0.64	0.59	0.095	0.043	0.74	0.52
DOC	1.39	1.52	1.59	1.85	1.63	1.60	0.170	0.076	1.85	1.39
FE	49.74	20.29	26.45	24.94	23.84	29.05	11.786	5.271	49.74	20.29
K	0.34	0.35	0.36	0.35	0.35	0.35	0.007	0.003	0.36	0.34
MG	0.56	0.56	0.56	0.55	0.52	0.55	0.018	0.008	0.56	0.52
MN	43.02	48.04	44.69	43.97	45.26	45.00	1.897	0.848	48.04	43.02
NA	0.48	0.49	0.50	0.48	0.48	0.48	0.011	0.005	0.50	0.48
NH4	18.06	14.86	12.08	8.51	24.21	15.54	5.987	2.677	24.21	8.51
NO3	18.97	22.27	15.04	10.08	23.34	17.94	5.459	2.441	23.34	10.08
TKN	146.10	143.63	167.91	152.92	149.89	152.09	9.530	4.262	167.91	143.63
pH	5.79	5.81	5.79	5.84	5.73	5.79	0.042	0.019	5.84	5.73
SO4	8.01	7.80	7.66	7.63	7.88	7.80	0.158	0.071	8.01	7.63
TP	3.69	3.49	3.53	3.45	4.35	3.70	0.372	0.167	4.35	3.45

CRADLE

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	41.26	45.76	43.52	45.57	40.61	43.34	2.381	1.065	45.76	40.61
ALKTI	6.55	12.65	8.66	9.58	6.03	8.69	2.653	1.186	12.65	6.03
AL	13.67	11.20	23.78	13.73	22.66	17.01	5.774	2.582	23.78	11.20
CA	1.83	1.91	1.77	1.88	1.81	1.84	0.057	0.025	1.91	1.77
CL	0.32	0.32	0.33	0.34	0.34	0.33	0.008	0.004	0.34	0.32
COND25	21.91	22.01	22.38	21.99	22.34	22.13	0.220	0.098	22.38	21.91
DIC	0.65	0.73	0.76	0.61	0.70	0.69	0.060	0.027	0.76	0.61
DOC	1.39	1.53	1.54	1.64	1.44	1.51	0.094	0.042	1.64	1.39
FE	99.27	120.25	115.09	81.08	66.29	96.40	22.736	10.168	120.25	66.29
K	0.30	0.30	0.29	0.30	0.28	0.29	0.006	0.003	0.30	0.28
MG	0.50	0.48	0.47	0.49	0.47	0.48	0.014	0.006	0.50	0.47
MN	33.72	36.16	33.17	31.13	31.87	33.21	1.942	0.869	36.16	31.13
NA	0.46	0.45	0.46	0.45	0.46	0.45	0.005	0.002	0.46	0.45
NH4	25.02	25.74	24.15	25.16	20.22	24.06	2.218	0.992	25.74	20.22
NO3	18.26	11.77	18.39	4.04	30.61	16.61	9.793	4.379	30.61	4.04
TKN	168.37	176.94	179.90	171.27	170.80	173.45	4.779	2.137	179.90	168.37
pH	5.78	5.78	5.71	5.82	5.56	5.73	0.104	0.046	5.82	5.56
SO4	6.69	6.58	6.60	6.61	6.90	6.68	0.133	0.059	6.90	6.58
TP	6.27	6.67	7.20	5.61	6.37	6.42	0.581	0.260	7.20	5.61

CROSSON

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	43.04	46.01	52.08	47.86	49.20	47.64	3.391	1.517	52.08	43.04
ALKTI	10.67	12.26	18.32	14.98	15.85	14.42	3.015	1.348	18.32	10.67
AL	66.68	81.79	85.35	82.24	87.79	80.77	8.246	3.688	87.79	66.68
CA	2.18	2.34	2.20	2.32	2.31	2.27	0.073	0.033	2.34	2.18
CL	0.42	0.41	0.41	0.41	0.42	0.41	0.007	0.003	0.42	0.41
COND25	25.93	26.88	26.76	26.14	27.12	26.56	0.508	0.227	27.12	25.93
DIC	0.82	0.99	1.15	0.90	1.08	0.99	0.133	0.060	1.15	0.82
DOC	3.84	4.10	4.50	4.48	4.43	4.27	0.289	0.129	4.50	3.84
FE	247.14	201.53	445.63	270.27	305.98	294.11	92.795	41.499	445.63	201.53
K	0.32	0.32	0.33	0.32	0.29	0.31	0.014	0.006	0.33	0.29
MG	0.65	0.65	0.63	0.64	0.63	0.64	0.011	0.005	0.65	0.63
MN	33.38	37.69	41.86	38.00	40.36	38.26	3.224	1.442	41.86	33.38
NA	0.65	0.65	0.66	0.65	0.65	0.65	0.006	0.003	0.66	0.65
NH4	16.29	16.76	21.95	22.81	25.87	20.74	4.114	1.840	25.87	16.29
NO3	105.97	92.80	10.65	81.69	71.86	72.59	36.885	16.495	105.97	10.65
TKN	262.27	273.12	332.91	269.93	281.89	284.02	28.219	12.620	332.91	262.27
pH	5.61	5.56	5.64	5.60	5.59	5.60	0.029	0.013	5.64	5.56
SO4	7.31	7.47	7.26	7.53	7.57	7.43	0.137	0.061	7.57	7.26
TP	10.24	9.92	12.48	7.56	8.42	9.73	1.890	0.845	12.48	7.56

DELANO

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	82.64	81.99	83.48	82.34	78.58	81.80	1.887	0.844	83.48	78.58
ALKTI	50.03	48.86	51.31	49.42	47.87	49.50	1.290	0.577	51.31	47.87
AL	45.37	64.46	62.88	68.62	88.27	65.92	15.334	6.857	88.27	45.37
CA	2.70	2.89	2.81	2.91	2.81	2.82	0.083	0.037	2.91	2.70
CL	0.35	0.35	0.40	0.37	0.37	0.37	0.021	0.009	0.40	0.35
COND25	30.58	32.27	33.29	32.17	32.33	32.13	0.977	0.437	33.29	30.58
DIC	1.46	1.47	1.66	1.35	1.60	1.51	0.124	0.055	1.66	1.35
DOC	4.77	5.05	5.10	5.11	5.88	5.18	0.413	0.185	5.88	4.77
FE	202.07	238.58	307.34	190.34	288.64	245.39	51.630	23.089	307.34	190.34
K	0.41	0.41	0.43	0.39	0.37	0.40	0.022	0.010	0.43	0.37
MG	0.93	0.94	0.95	0.94	0.92	0.94	0.010	0.005	0.95	0.92
MN	56.63	79.76	86.86	61.21	97.90	76.47	17.351	7.759	97.90	56.63
NA	0.76	0.78	0.80	0.78	0.79	0.78	0.015	0.007	0.80	0.76
NH4	14.36	14.05	14.21	9.66	17.11	13.88	2.676	1.197	17.11	9.66
NO3	106.58	111.46	119.01	89.21	105.25	106.30	10.969	4.905	119.01	89.21
TKN	257.94	275.87	293.45	268.80	291.03	277.47	14.985	6.701	293.45	257.94
pH	6.12	6.06	6.03	6.13	5.94	6.05	0.078	0.035	6.13	5.94
SO4	7.71	8.33	8.42	8.51	8.47	8.29	0.331	0.148	8.51	7.71
TP	7.13	7.96	8.00	7.46	6.81	7.47	0.516	0.231	8.00	6.81

HAMER

	Oct 20	Nov. 06								
PARAMETER	**1988**	**1989**	**1990**	**1991**	**1992**	**MEAN**	**StdDev**	**SE**	**MAX**	**MIN**
ALKT	45.4	40.6	54.78	60.89	53.23	50.98	8.009	3.582	60.89	40.60
ALKTI	14.7	9.9	23.58	29.38	25.47	20.61	8.046	3.598	29.38	9.90
AL	160	177	159.29	143.64	189.61	165.91	17.742	7.934	189.61	143.64
CA	2.8	3.5	3.00	2.95	2.81	3.01	0.286	0.128	3.50	2.80
CL	1.7	1.88	1.89	2.15	2.37	2.00	0.263	0.118	2.37	1.70
COND25	30.9	38.2	33.31	30.56	30.98	32.79	3.215	1.438	38.20	30.56
DIC	0.73	2.05	1.12	1.10	1.05	1.21	0.496	0.222	2.05	0.73
DOC	10.4	9.6	8.71	8.21	9.46	9.27	0.847	0.379	10.40	8.21
FE		333	415.42	436.59	472.46	414.37	59.134	29.567	472.46	333.00
K	0.5	0.55	0.49	0.41	0.44	0.48	0.054	0.024	0.55	0.41
MG	0.64	0.72	0.65	0.63	0.59	0.65	0.048	0.022	0.72	0.59
MN		46	35.83	39.19	36.12	39.29	4.728	2.364	46.00	35.83
NA	0.81	0.99	1.00	1.01	1.07	0.98	0.098	0.044	1.07	0.81
NH4	57	62	37.50	16.10	44.12	43.34	18.106	8.097	62.00	16.10
NO3	30	113	31.20	11.22	42.73	45.63	39.319	17.584	113.00	11.22
TKN	500	453	448.80	363.47	462.23	445.50	50.115	22.412	500.00	363.47
pH	5.34	5.07	5.52	5.65	5.48	5.41	0.221	0.099	5.65	5.07
SO4	6.6	8.4	6.86	6.21	5.65	6.74	1.032	0.461	8.40	5.65
TP	11.5	10.5	12.19	11.48	10.20	11.17	0.810	0.362	12.19	10.20

HARP

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	100.57	103.33	105.90	109.23	107.00	105.21	3.354	1.500	109.23	100.57
ALKTI	68.67	69.16	73.12	75.94	75.01	72.38	3.326	1.488	75.94	68.67
AL	26.29	31.46	30.16	36.63	37.99	32.51	4.805	2.149	37.99	26.29
CA	2.86	2.92	2.85	3.01	2.95	2.92	0.066	0.030	3.01	2.85
CL	1.21	1.41	1.61	1.88	2.41	1.70	0.465	0.208	2.41	1.21
COND25	33.78	34.97	36.55	36.84	38.91	36.21	1.951	0.873	38.91	33.78
DIC	1.42	1.47	1.57	1.50	1.55	1.50	0.061	0.027	1.57	1.42
DOC	3.50	3.61	3.52	3.68	3.83	3.63	0.134	0.060	3.83	3.50
FE	70.05	65.53	57.30	67.50	59.13	63.90	5.474	2.448	70.05	57.30
K	0.56	0.57	0.57	0.55	0.53	0.56	0.018	0.008	0.57	0.53
MG	0.94	0.93	0.93	0.95	0.94	0.94	0.009	0.004	0.95	0.93
MN	15.52	14.75	19.55	18.70	17.28	17.16	2.035	0.910	19.55	14.75
NA	1.23	1.35	1.44	1.56	1.79	1.47	0.216	0.097	1.79	1.23
NH4	7.67	7.44	8.16	8.62	13.85	9.15	2.668	1.193	13.85	7.44
NO3	108.19	116.40	95.46	99.17	97.81	103.41	8.719	3.899	116.40	95.46
TKN	214.37	216.51	226.55	217.54	216.48	218.29	4.758	2.128	226.55	214.37
pH	6.36	6.34	6.32	6.41	6.35	6.36	0.033	0.015	6.41	6.32
SO4	7.48	7.45	7.45	7.51	7.37	7.45	0.053	0.024	7.51	7.37
TP	7.02	7.67	7.10	6.11	6.35	6.85	0.626	0.280	7.67	6.11

PINCHER

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	31.68	36.39	36.30	43.90	42.41	38.14	4.987	2.230	43.90	31.68
ALKTI	-1.30	2.28	-1.05	9.09	7.52	3.31	4.807	2.150	9.09	-1.30
AL	62.25	84.83	82.81	75.82	84.54	78.05	9.557	4.274	84.83	62.25
CA	1.63	1.60	1.46	1.50	1.41	1.52	0.092	0.041	1.63	1.41
CL	0.29	0.31	0.32	0.30	0.27	0.30	0.020	0.009	0.32	0.27
COND25	21.73	21.89	21.97	20.05	19.89	21.10	1.041	0.465	21.97	19.89
DIC	0.46	0.60	0.75	0.79	0.84	0.69	0.156	0.070	0.84	0.46
DOC	2.34	2.60	2.49	2.65	2.96	2.61	0.230	0.103	2.96	2.34
FE	70.19	91.29	123.19	148.24	130.85	112.75	31.495	14.085	148.24	70.19
K	0.35	0.39	0.45	0.43	0.39	0.40	0.037	0.016	0.45	0.35
MG	0.46	0.45	0.44	0.43	0.40	0.44	0.023	0.010	0.46	0.40
MN	47.21	64.21	58.75	61.54	67.47	59.84	7.760	3.470	67.47	47.21
NA	0.56	0.57	0.57	0.53	0.53	0.55	0.021	0.010	0.57	0.53
NH4	27.62	40.11	53.40	46.66	46.64	42.89	9.739	4.356	53.40	27.62
NO3	43.48	109.84	143.94	52.63	32.96	76.57	47.997	21.465	143.94	32.96
TKN	192.46	234.30	268.14	243.22	269.47	241.52	31.431	14.056	269.47	192.46
pH	5.37	5.37	5.40	5.54	5.47	5.43	0.075	0.033	5.54	5.37
SO4	6.62	6.15	5.98	5.98	5.79	6.10	0.313	0.140	6.62	5.79
TP	4.31	5.40	5.12	5.94	5.29	5.21	0.591	0.264	5.94	4.31

PLASTIC

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	41.76	42.96	40.76	44.56	42.36	42.36	1.399	0.619	44.56	40.76
ALKTI	8.39	7.19	5.99	9.59	7.59	7.79	1.339	0.599	9.59	5.99
ALUT	22.14	26.29	27.80	38.03	39.64	30.78	7.660	3.426	39.64	22.14
CA	1.95	2.01	1.87	1.97	1.84	1.93	0.072	0.032	2.01	1.84
CL	0.39	0.39	0.40	0.41	0.42	0.40	0.012	0.005	0.42	0.39
COND25	22.09	22.32	22.65	21.77	22.11	22.19	0.326	0.146	22.65	21.77
DIC	0.46	0.52	0.57	0.53	0.51	0.52	0.040	0.018	0.57	0.46
DOC	1.98	2.04	2.06	2.18	2.14	2.08	0.076	0.034	2.18	1.98
FE	92.68	70.29	63.21	88.22	77.20	78.32	12.230	5.469	92.68	63.21
K	0.21	0.21	0.21	0.21	0.20	0.21	0.003	0.001	0.21	0.20
MG	0.49	0.47	0.47	0.48	0.45	0.47	0.014	0.006	0.49	0.45
MN	40.27	44.61	43.23	52.32	49.09	45.90	4.793	2.143	52.32	40.27
NA	0.50	0.51	0.52	0.53	0.51	0.51	0.010	0.005	0.53	0.50
NH4	24.90	14.88	13.89	15.69	23.03	18.48	5.091	2.277	24.90	13.89
NO3	23.68	20.47	17.06	8.91	23.35	18.69	6.083	2.721	23.68	8.91
TKN	186.14	181.46	164.23	180.76	173.13	177.14	8.598	3.845	186.14	164.23
pH	5.82	5.77	5.68	5.75	5.73	5.75	0.052	0.023	5.82	5.68
SO4	6.67	6.54	6.63	6.57	6.51	6.58	0.066	0.029	6.67	6.51
TP	5.06	5.98	5.11	4.83	4.30	5.06	0.607	0.272	5.98	4.30

SKIDWAY

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	31.53	44.81	48.08	40.38	37.26	40.41	6.460	2.889	48.08	31.53
ALKTI	-2.05	11.69	13.32	5.94	2.90	6.36	6.320	2.826	13.32	-2.05
ALUT	89.59	62.26	81.56	71.48	110	82.98	18.284	8.177	110.00	62.26
CAUR	1.31	1.33	1.30	1.32	1.19	1.29	0.056	0.025	1.33	1.19
CLIDUR	0.41	0.49	0.51	0.41	0.445	0.45	0.047	0.021	0.51	0.41
COND25	19.64	19.29	19.67	18.34	18.05	19.00	0.755	0.337	19.67	18.05
DIC	0.49	0.98	0.90	0.68	0.605	0.73	0.207	0.092	0.98	0.49
DOC	3.13	3.79	3.80	3.53	3.6	3.57	0.273	0.122	3.80	3.13
FEUT	173.08	514.35	648.35	417.73	236	397.90	195.852	87.586	648.35	173.08
KKUR	0.28	0.42	0.38	0.33	0.31	0.34	0.057	0.026	0.42	0.28
MGUR	0.42	0.41	0.41	0.41	0.39	0.41	0.011	0.005	0.42	0.39
MNUT	64.86	79.46	79.38	72.33	77.5	74.71	6.220	2.781	79.46	64.86
NAUR	0.61	0.62	0.61	0.56	0.5675	0.59	0.024	0.011	0.62	0.56
NNHTFR	20.83	51.85	59.44	22.97	49	40.82	17.703	7.917	59.44	20.83
NNOTFR	18.57	26.05	24.13	14.56	28.5	22.36	5.693	2.546	28.50	14.56
NNTKUR	258.12	336.13	375.52	299.82	325	318.92	43.582	19.490	375.52	258.12
PH	5.28	5.56	5.52	5.44	5.375	5.43	0.112	0.050	5.56	5.28
SSO4UR	5.46	4.83	4.74	5.14	4.775	4.99	0.305	0.136	5.46	4.74
TP	6.75	7.99	8.85	9.90	9.15	8.53	1.209	0.541	9.90	6.75

WESTWARD

PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	80.24	79.09	80.56	89.82	89.12	83.77	5.242	2.344	89.82	79.09
ALKTI	46.55	43.25	47.11	55.13	54.63	49.34	5.278	2.360	55.13	43.25
AL	5.43	6.25	8.27	5.97	16.55	8.49	4.630	2.070	16.55	5.43
CA	2.16	2.28	2.05	2.20	2.11	2.16	0.087	0.039	2.28	2.05
CL	0.27	0.28	0.29	0.30	0.29	0.29	0.010	0.004	0.30	0.27
COND25	24.34	24.34	24.16	24.02	24.12	24.19	0.142	0.063	24.34	24.02
DIC	1.25	1.19	1.23	1.20	1.42	1.26	0.095	0.042	1.42	1.19
DOC	1.41	1.46	1.43	1.57	1.53	1.48	0.069	0.031	1.57	1.41
FE	72.81	76.53	85.54	142.71	122.12	99.94	30.872	13.806	142.71	72.81
K	0.36	0.36	0.36	0.36	0.36	0.36	0.002	0.001	0.36	0.36
MG	0.60	0.60	0.57	0.59	0.57	0.59	0.017	0.008	0.60	0.57
MN	83.84	80.30	88.46	111.90	87.82	90.47	12.429	5.558	111.90	80.30
NA	0.54	0.53	0.53	0.52	0.52	0.53	0.009	0.004	0.54	0.52
NH4	33.15	16.08	18.67	21.73	31.82	24.29	7.759	3.470	33.15	16.08
NO3	79.48	134.56	129.22	90.16	59.57	98.60	32.369	14.476	134.56	59.57
TKN	165.99	162.85	152.72	185.54	165.52	166.52	11.904	5.324	185.54	152.72
PH	6.34	6.27	6.31	6.44	6.32	6.34	0.066	0.030	6.44	6.27
SO4	5.93	6.10	5.86	5.84	6.14	5.97	0.140	0.063	6.14	5.84
TP	4.14	4.49	3.54	4.18	3.67	4.01	0.391	0.175	4.49	3.54

YOUNG

	Oct 20	Nov. 06								
PARAMETER	1988	1989	1990	1991	1992	MEAN	StdDev	SE	MAX	MIN
ALKT	131.5	132.10	133.63	135.76	131.72	132.94	1.781	0.797	135.76	131.50
ALKTI	98.00	98.80	99.86	102.60	101.88	100.23	1.966	0.879	102.60	98.00
AL	7.00	10.00	16.43	15.21	19.75	13.68	5.123	2.291	19.75	7.00
CA	2.9	2.90	2.75	2.89	2.79	2.85	0.072	0.032	2.90	2.75
CL	0.30	0.38	0.38	0.39	0.40	0.37	0.040	0.018	0.40	0.30
COND25	30.10	31.80	30.91	30.52	30.34	30.73	0.665	0.297	31.80	30.10
DIC	1.29	1.78	1.67	1.51	1.62	1.57	0.186	0.083	1.78	1.29
DOC	3.50	3.00	3.04	3.23	3.07	3.17	0.205	0.092	3.50	3.00
FE		39.00	33.39	32.14	38.93	35.87	3.616	1.808	39.00	32.14
K	0.59	0.57	0.56	0.55	0.53	0.56	0.023	0.010	0.59	0.53
MG	0.76	0.78	0.75	0.77	0.73	0.76	0.019	0.008	0.78	0.73
MN			49.06	34.32	34.79	39.39	8.375	4.835	49.06	34.32
NA	0.95	0.94	0.94	0.92	0.92	0.93	0.012	0.006	0.95	0.92
NH4	9.00	11.00	14.89	11.52	13.39	11.96	2.262	1.012	14.89	9.00
NO3			65.54	63.78	68.35	65.89	2.307	1.332	68.35	63.78
TKN	210	223.00	245.10	232.78	233.76	228.93	13.164	5.887	245.10	210.00
pH	6.88	6.37	6.60	6.82	6.63	6.66	0.202	0.090	6.88	6.37
SO4	6.80	6.50	6.19	6.28	6.51	6.46	0.236	0.106	6.80	6.19
TP	8.30	8.60	8.46	7.52	7.66	8.11	0.485	0.217	8.60	7.52

APPENDIX 5

LAKE INVENTORY DATA SUMMARIES WITH SAMPLING SITE DESCRIPTIONS

Substrate types:
LOS - highly organic flocculent
CSD - coarse sand
SLT - silt
COB - cobble
PEB - pebbles
BON - boulders
BDR - bedrock

BLUE CHALK

Drainage System	Black River drainage watershed (2EC15). The outflow enters Red Chalk Lake which flows southward into the Pairo Lakes. The Pairo Lakes then flow to a creek en route to the Black River which eventually reaches Lake Simcoe.
Geology	Minor till plain is the major surficial deposit (on average) at Blue Chalk, and the bedrock type is granitized biotite gneiss.
Crayfish Species	*Cambarus bartoni, Orconectes propinquus* and *Orconectes virilis* (Reid and David 1990).
Stresses	
Acidification:	The lake is rated as moderately sensitive to acid loading (Alkalinity = 84.2 $\mu eq \cdot L^{-1}$).
Eutrophication:	Secchi depth measurements (mean value = 6.0 m) and the chemical parameter total phosphorus (ice-free mean value = 5.65 $\mu eq \cdot L^{-1}$) indicate that Blue Chalk Lake is oligotrophic.
Site #1 CSD COB	shoreline - t-brush, logs, birch, white pine, cedar and spruce trees. substrate - sand (50% of the site), rocks (40%), macro Eriocaulon coverage (5%) and 5% sticks.
Site #2 LOS	shoreline - logs, t-brush, birch and white pine trees. substrate - detritus (70%) and 30% logs/sticks.
Site #3 LOS	shoreline - t-brush, cedar, birch, white pine and balsam fir trees. substrate - detritus (65% of the site) and 35% stick/logs.
Site #4 CSD PEB LOS	shoreline - t-brush, logs, cedar, birch, white pine, maple and balsam fir trees substrate - sand/PEB (45% of the site), detritus (40%), sticks/logs 10%) and 5% macros.
Site #5 CSD	shoreline - t-brush, logs, birch, cedar, white pine and maple trees. substrate - sand (75% of the site), macros (20%) and 5% logs/sticks.

CLEAR LAKE

Drainage System: Cameron Lake drainage watershed (2HF08).

The outflow enters Big Hawk Lake which flows southward to Halls Lake. Halls Lake flows through Boshkung, Mountain and Horseshoe Lakes en route to the Gull River which eventually reaches Lake Simcoe and then Georgian Bay in Lake Huron (Reid and Snyder 1986).

Geology The surficial cover is dominated by thin till and rock ridges. The biotite gneiss is composed of metamorphosed beds of greywacke, arkose and sandstone (Reid and Snyder 1986). The bedrock type is biotite gneiss with traces of small marble interbeds.

Crayfish Species: *Cambarus bartoni* and *Orconectes propinquus*.

Stresses

Acidification: The lake is rated as extremely sensitive to acid loading (Alkalinity = 7.8 $\mu eq \cdot L^{-1}$).

Eutrophication: Cultural eutrophication is not a stress in Clear Lake. Secchi depth measurements (mean value = 7.8 m) and the chemical parameter total phosphorus (ice-free mean value = 3.8 $\mu eq \cdot L^{-1}$) indicate that Clear Lake is oligotrophic.

Site #1
CSD COB
shoreline - lab. tea, white pine and hemlock trees.
substrate - sand (70% of the site) and 30% cobble.

Site #2
CSD COB
shoreline - bedrock, boulders, white pine and cedar trees.
substrate - sand (70% of the site) and 30% rocks/cobble.

Site #3
CSD LOS
shoreline - lab. tea, white pine and cedar trees.
substrate - sand (50% of the site), detritus (30%) and 20% macros.

Site #4
CSD COB
shoreline - lab. tea and cedar trees.
substrate - sand (60% of the site), macros (30%) and 10% rock.

Site #5
LOS
shoreline - bedrock, lab. tea, white pine and hemlock trees.
substrate - detritus (70% of the site), Eriocaulon (20%) and 10% logs.

CRADLE LAKE

Drainage System

Upper Madawaska River watershed (2KD18).

The outflow is south into Bonnechere Lake which flows into Phipps Lake and then on through a series of lakes which eventually lead to the Upper Madawaska River and on to the Ottawa River.

Geology The surficial cover of the watershed consist of (22.7% of the area) by sand and gravel, underlined with 44.6% of unsubdivided veneer. Bedrock knobs account for 0.4% of the watershed. The bedrock in this watershed consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks (100% of the land area).

Crayfish Species

Cambarus bartoni.

Stresses

Acidification:

The lake is rated as extremely sensitive to acid loading (Alkalinity = 9.4 $\mu eq \cdot L^{-1}$).

Eutrophication:

Secchi depth measurements (mean value = 7.7 m) and the chemical parameter total phosphorus (ice-free mean value = 6.2 $\mu eq \cdot L^{-1}$) indicate that Cradle Lake is oligotrophic.

Site #1
LOS CSD COB

shoreline - leather leaf, black spruce and tamarack trees.
substrate - detritus (40% of the site), sand (35%), sticks & logs (20%) and 5% rocks.

Site #2
LOS

shoreline - leather leaf and tamarack trees.
substrate - detritus (80% of the site) and 20% logs/sticks.

Site #3
COB PEB
CSD LOS

shoreline - leather leaf.
substrate - rock/stones (40% of the site), sand (30%), logs/sticks (25%) and 5% detritus.

Site #4
LOS

shoreline - black spruce, white pine, cedar and hemlock trees.
substrate - detritus (80% of the site), and 20% logs/sticks.

Site #5
LOS

shoreline - "dead heads", cedar and hemlock trees.
substrate - LOS (100% of the site).

CROSSON LAKE

Drainage System	Black River drainage watershed (2EC15). The outflow joins Clear Creek which flows southward into the Black River. The Black River then eventually reaches Lake Simcoe.
Geology	The surficial geology of Crosson Lake is composed of peat and ponded areas surrounded by expanses of thin till and rock ridges. The bedrock type in this basin is migmitite (0-30% mafic).
Crayfish Species	*Cambarus bartoni* and *Orconectes virilis.*
Stresses	
Acidification:	The lake is rated as extremely sensitive to acid loading (Alkalinity = 9.0 $\mu eq{\cdot}L^{-1}$).
Eutrophication:	Secchi depth measurements (mean value = 3.5 m) and the chemical parameter total phosphorus (ice-free mean value = 10.2 $\mu eq{\cdot}L^{-1}$) indicate that Crosson Lake is mesotrophic.
Site #1 COB PEB CSD LOS	shoreline - mostly boulders & bedrock, T-brush, hemlocks, large pines, balsam firs, oaks and ferns. substrate - rocks & PEB (45% of the site), sand (45%), macros (5%) and 5% detritus.
Site #2 LOS COB CSD	shoreline - large rocks, T-brush, hemlocks, birches, oaks and floating logs substrate - logs/sticks (60% of the site), detritus (20%), rock (10%), sand (5%) and 5% macros.
Site #3 CSD LOS	shoreline - T-brush, floating logs, birch, balsam fir and large pine trees. substrate - sand (60% of the site), detritus (20%), sticks (10%) and 10% macros (lily pads).
Site #4 CSD LOS	shoreline - marsh like area (T-brush back about 40'), cedar, tall pines, hemlock, birch and floating logs. substrate - sand (30% of the site), sticks (30%), detritus (30%) and 10% macros (arrowheads & lily pads).
Site #5 LOS COB CSD	shoreline - mostly hemlock, two yellow birches, ferns, and fallen trees. substrate - detritus (50% of the site), macros (20%), rocks (10%), sand (10%) and 10% sticks.

DELANO LAKE

Drainage System — Upper Madawaska River drainage watershed (2KD1).

The lake flows through Cache Lake and into the Upper Madawaska River. The Madawaska River flows east through a series of lakes to enter the Ottawa River at Arnprior.

Geology — The surficial cover consist of bedrock knobs and ridges with very thin, discontinuous drift cover (56.4%). Adjacent areas of thin drift with numerous outcrops (12.0% of the area) are accompanied by glaciofluvial outwash (12.7%). Organic depositions (8.8%) follow Delano Creek from the one pond (0.4% of the area) to Delano Lake. The bedrock geology consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks (76.1% of the land area).

Crayfish Species — *Cambarus bartoni, Orconectes propinquus* and *Orconectes virilis.*

Stresses

Acidification: The lake is rated as moderately sensitive to acid loading (Alkalinity = 46 $\mu eq \cdot L^{-1}$).

Eutrophication: Secchi depth measurements (mean value = 3.8 m) and the chemical parameter total phosphorus (ice-free mean value = 7.1 $\mu eq \cdot L^{-1}$) indicate that Delano Lake is oligotrophic.

Site #1
LOS
shoreline - floating logs with sphagnum, leather leaf, black spruce and cedar trees.
substrate - macrophytes (50% of the site), and 50% detritus.

Site #2
LOS COB
shoreline - leather leaf, cedar and hemlock trees.
substrate - detritus (60% of the site), sticks (30%) and 10% rocks.

Site #3
LOS
shoreline - leather leaf, cedar and hemlock trees.
substrate - detritus (70% of the site) and 30% sticks.

Site #4
LOS
shoreline - leather leaf, balsam fir and hemlock trees.
substrate - detritus (90% of the site) and 10% sticks.

Site #5
BOU LOS
shoreline - leather leaf along shore, accompanied by hemlock trees.
substrate - BOU (80% of the site) and 20% detritus.

HAMER LAKE

Drainage System	Lake Rosseau drainage watershed (2EB5). The outflow enters Silver Lake which flows south-east into Gordon Bay on Lake Joseph.
Geology	The bedrock geology of this watershed consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks.
Crayfish Species	*Orconectes virilis.*
Stresses	
Acidification:	The lake is rated as extremely sensitive to acid loading (Alkalinity = 7.2 μeq·L^{-1}).
Eutrophication:	Secchi depth measurements (mean value = 1.8 m) and the chemical parameter total phosphorus (ice-free mean value = 11.3 μeq·L^{-1}) indicate that Hamer Lake is mesotrophic.
Site #1 LOS	shoreline - grasses, Labrador tea, several dead trees, pine and birch trees. substrate - detritus (60%), Eriocaulon and arrow heads (35%) and 5% logs.
Site #2 LOS CSD	shoreline - submerged ferns, Labrador tea, floating grasses, logs, dead fallen trees, pine, hemlock and snull pie/hemlock trees. substrate - macros: lilypads and Eriocaulon (40%), detritus (25%), sand (20%) and 15% logs.
Site #3 BDR	shoreline - Labrador tea, grasses, floating logs, large rocks, hemlock and white pine trees. substrate - macros: arrow-head and Eriocaulon (40%), rock shelf (30%), BDR (20%) and 10% logs.
Site #4 SLT LOS COB	shoreline - few rocks along shoreline, Labrador tea, grasses, white pines, oaks and maple. substrate - SLT/detritus (40%), macrophytes Ericocaulon (40%), rocks (10%) and 10% sticks.
Site #5 LOS	shoreline - tall pines, hemlock trees, Labrador tea, grasses, ferns, birch trees, floating logs and several dead trees. substrate - detritus (50%), sticks/logs (25%) and macros: lilypads (25%).

HARP LAKE

Drainage System

Upper North Branch Muskoka River drainage watershed (2EB13).

The outflow enters Peninsula Lake which flows south-west to Fairy Lake. Fairy Lake then flows into the North Branch Muskoka River. The Muskoka and Moon River system finally enters into Georgian Bay on Lake Huron.

Geology Minor till plain is the major surficial deposit at Harp Lake. The bedrock geology in this basin consist of granitized biotite and hornblende gneiss, diorite and amphibolite and schist.

Crayfish Species

Cambarus bartoni and *Orconectes propinquus.*

Stresses

Acidification:

The lake is rated as moderately sensitive to acid loading (Alkalinity = 68 $\mu eq \cdot L^{-1}$).

Eutrophication:

Secchi depth measurements (mean value = 3.8 m) and the chemical parameter total phosphorus (ice-free mean value = 7.1 $\mu eq \cdot L^{-1}$) indicate that Harp Lake is oligotrophic.

Site #1
LOS CSD

shoreline - t-brush, birch and balsam fir trees.
substrate - detritus (35% of the site), macros (Eriocaulon, Lobelia and arrow heads, 25% coverage) and 20% sand.

Site #2
COB CSD

shoreline - rock face (15' high), hemlock, birch and pine trees.
substrate - rocks and COB (65% of the site), sand (30%) and 5% macros (Eriocaulon).

Site #3
CSD COB

shoreline - brush, old stumps, cedar, pine, hemlock and birch trees.
substrate - sand (70% of the site), rocks (20%), sticks (5%) and 5% macros (Eriocaulon).

Site #4
CSD COB

shoreline - t-brush, floating logs, yellow birch, cedar and balsam firs.
substrate - sand (40% of the site), macros (Eriocaulon coverage 40%), rocks (10%) and 10% sticks.

Site #5
LOS COB
PEB CSD

shoreline - hemlock, yellow birch, white birch and cedar trees.
substrate - sticks & logs (40% of the site), detritus (25%), rocks/pebbles (20%), macros (10%) and 5% sand.

PINCHER LAKE

Drainage System — Moon River and Go Home River watershed (2EB13).

The outflow runs southwest to Clara Lake which flows through a series of lakes which eventually leads to Lake Huron.

Geology — The surficial cover is dominated (61.8% of the area) by bedrock knobs and ridges, with very thin discontinuous drift cover. Sections of till account for 19.1% of the watershed. Pond areas cover 2.4%, and swamp and organic deposits cover 2.7% of the watershed. The bedrock geology consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks (96.7% of the land area).

Crayfish Species — *Cambarus bartoni.*

Stresses

Acidification: The lake is rated as extremely sensitive to acid loading (Alkalinity = -1 $\mu eq \cdot L^{-1}$).

Eutrophication: Secchi depth measurements (mean value = 5.3 m) and the chemical parameter total phosphorus (ice-free mean value = 7.5 $\mu eq \cdot L^{-1}$) indicate that Pincher Lake is oligotrophic.

Site #1 COB LOS	shoreline - leather leaf, cedar, black spruce and tamarack trees. substrate - rocks (40% of the site), detritus (30%) and 30% sticks.
Site #2 LOS	shoreline - leather leaf. substrate - detritus (80% of the site), and 20% sticks.
Site #3 LOS CSD COB	shoreline - leather leaf, hemlock, cedar and black spruce. substrate - detritus (50% of the site), sand (20%), rocks (10%), sticks (10%) and 10% macrophytes.
Site #4 LOS COB	shoreline - leather leaf, hemlock, cedar and black spruce. substrate - detritus (55% of the site), sticks (40%) and 5% rocks.
Site #5 LOS	shoreline - leather leaf and cedar trees. substrate - logs/sticks (60% of the site), and 40% detritus.

PLASTIC LAKE

Drainage System: Cameron Lake drainage watershed (2HF10).

The outflow runs south to St. Nora Lake. St. Nora Lake eventually flows through Boshkung, Mountain and Horseshoe Lakes en route to the Gull River which eventually reaches Lake Simcoe and then Georgian Bay in Lake Huron (Girard et al. 1985).

Geology The surficial cover of the watershed is dominated by a shallow, discontinuous, sand basal till containing angular to sub-angular boulders (Girard et al. 1985). The bedrock is an erosion and weather resistant gneiss, with a substantial igneous component. A small meta-gabbro plug appears on the east shoreline of the lake.

Crayfish Species: No crayfish were caught in the 1988 study .

Stresses

Acidification: The lake is rated as extremely sensitive to acid loading (Alkalinity = 12 $\mu eq \cdot L^{-1}$).

Eutrophication: Cultural eutrophication is not a stress. Secchi depth measurements (mean value = 6.1 m) and the chemical parameter total phosphorus (ice-free mean value = 5.1 $\mu eq \cdot L^{-1}$) indicate that Plastic Lake is oligotrophic.

Site #1
shoreline - medium size rocks, "dead heads", white pine, cedars and white birch.
COB LOS CSD
substrate - rocks/sticks (50%), detritus (20%), sand (10%) and 10% macrophytes Eriocaulon.

Site #2
shoreline - Labrador tea, flat rock, large dead trees and saplings of white pine.
LOS
substrate - mixture of LOS and detritus, accompanied with 60% macrophytes.

Site #3
shoreline - located near the mouth of the stream (pc1). The shoreline consists of large flat rocks with lots of vegetation (several species of grasses).
LOS
substrate - logs (40% of the site) and 30% macrophyte Eriocaulon.

Site #4
shoreline - rocky bottom accompanied by "dead heads". The type of trees to be seen were hemlock, white pine, cedar and Labrador tea (type of shrub).
COB CSD SLT
substrate - rocks (50%), sand/SLT (20%), macrophytes (20%) and 10% logs/boulders.

Site #5
shoreline - The shoreline contains bedrock up to the waterline. The types of trees to be seen were hemlocks and large white pines.
LOS COB BOU
substrate - logs/sticks (50%), rocks/BOU (30%) and 20% macrophytes.

SKIDWAY LAKE

Drainage System	Moon River and Go Home River watershed (2EB2). The outflow runs south to Code Lake and eventually drains into Lake Huron via a variety of small lakes.
Geology	The surficial cover is dominated by thin drift (83.3%), while the remaining 16.7% is lake surface area. The bedrock geology in this watershed consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks (100% of the land area).
Crayfish Species	*Orconectes virilis.*
Stresses	
Acidification:	The lake is rated as extremely sensitive to acid loading (Alkalinity = -4.8 $\mu eq \cdot L^{-1}$).
Eutrophication:	Cultural eutrophication is not a stress. Secchi depth measurements (mean value = 4.4 m) and the chemical parameter total phosphorus (ice-free mean value = 6.7 $\mu eq \cdot L^{-1}$) indicate that Skidway Lake is oligotrophic.
Site #1 LOS	shoreline - leather leaf, hemlock and red oak trees. substrate - detritus (90% of the site), and 10% sticks/logs.
Site #2 LOS	shoreline - stumps, sticks, hard stem bulrush and hemlock trees. substrate - hard stem bulrush (50% of the site).
Site #3 LOS	shoreline - leather leaf, hemlock and red oak trees. substrate - detritus (65% of the site), and 35% sticks.
Site #4 LOS	shoreline - water lily, arrow heads, leather leaf, white pine and hemlock trees. substrate - detritus (70% of the site), sticks (20%) and 10% macrophytes.
Site #5 LOS CSD	shoreline - leather leaf flood plain with sticks and logs. substrate - detritus and sand.

WESTWARD LAKE

Drainage System	Oxtongue River drainage watershed (2EB11). Westward flows through a pond and enters the Oxtongue River. The flow then continues through to Lake of Bays and into the South Muskoka River. The Muskoka and Moon River system finally enters into Georgian Bay on Lake Huron.

Geology The surficial cover is dominated by bedrock knobs and ridges with very thin, discontinuous drift (49.4%). Adjacent areas of thin drift with numerous outcrops (17.6% of the area) are accompanied by glaciofluvial outwash (4.9%). The only pond which is located at the north end of Westward Lake accounts for 0.5% of the watershed. The bedrock geology consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks (93.1% of the land area).

Crayfish Species	*Cambarus bartoni* and *Orconectes propinquus.*
Stresses Acidification:	The lake is rated as moderately sensitive to acid loading (Alkalinity = 42.1 μeq·L^{-1}).
Eutrophication:	Secchi depth measurements (mean value = 6.4 m) and the chemical parameter total phosphorus (ice-free mean value = 4.4 μeq·L^{-1}) indicate that Westward Lake is oligotrophic.
Site #1 LOS CSD	shoreline - cedar and black spruce trees. substrate - thin veneer detritus (50% of the site), sticks/logs (30%) and 20% exposed sand.
Site #2 LOS	shoreline - cedar and black spruce trees. substrate - sticks/logs (100% of the site detritus).
Site #3 CSD LOS COB	shoreline - cedar trees. substrate - sand (40% of the site), detritus (40%), rocks (10%) and 10% sticks/logs.
Site #4 COB CSD	shoreline - leather leaf and black spruce trees. substrate - rocks (80% of the site), sand (10%) and 10% sphagnum moss.
Site #5 LOS COB	shoreline - leather leaf, cedar, white pine and black spruce trees. substrate - detritus, logs/sticks and rocks (percentages unknown).

YOUNG LAKE

Drainage System	Skeleton River drainage watershed (2EB7). The outflow joins Skeleton River which flows into Skeleton Bay on Lake Rosseau.
Geology	The bedrock geology in this watershed consists of granite, gneiss, quartzose sandstone, syenitic and associated alkalic rocks.
Crayfish Species	*Cambarus bartoni* and *Orconectes propinquus.*
Stresses	
Acidification:	The lake is rated as moderately sensitive to acid loading (Alkalinity = 90.2 $\mu eq\cdot L^{-1}$).
Eutrophication:	Secchi depth measurements (mean value = 5.7 m) and the chemical parameter total phosphorus (ice-free mean value = 7.5 $\mu eq\cdot L^{-1}$) indicate that Young Lake is oligotrophic.
Site #1	shoreline - grasses, white pine, birch, cedar, balsam fir and maple trees.
CSD PEB SLT LOS	substrate - macros (Eriocaulon mats, coverage 40%), sand/PEB (30%), SLT/detritus (25%) and 5% sticks.
Site #2	shoreline - t-brush, floating logs, white pine, oak, birch and balsam fir trees.
CSD LOS	substrate - sand (85% of the site), detritus (10%) and 5% sticks.
Site #3	shoreline - floating logs, cedar, birch, white pine and hemlock trees.
CSD LOS	substrate - sand (80% of the site), detritus (10%), sticks/logs (5%) and 5% macrophytes (Eriocaulon).
Site #4	shoreline - t-brush, grasses, floating logs, cedar, birch and hemlock trees.
SLT LOS	substrate - SLT/detritus (45% of the site), macros (reeds and Eriocaulon mats, coverage 45%) and 10% logs.
Site #5	shoreline - t-brush, white pine, cedar, birch and hemlock trees.
CSD LOS	substrate - sand (50% of the site), detritus (40%) and 10% logs/sticks.

APPENDIX 6

FALL 1988 - 1992 BENTHIC GENUS LISTS FOR EACH LAKE

	BLUE CHALK					CLEAR					CRADLE				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Acanthocephala															
Genus indet. F92															
Nemertea															
Prostoma															
Coelenterata															
Hydra															
Turbellaria		**7**	**7**		**14**										
Dugesia		7	7		14										
Nematoda	**14**	**19**	**7**	**7**	**1**	**5**	**4**	**15**	**6**	**7**		**2**			
Anatonchus	8	13	6	1		4	1	15	4	2		2			
Dorylaimus															
Mermithidae	6	6	1	6	1	1	3		2	5					
Mononchus															
Paractinolaimus															
Oligochaeta	**42**	**113**	**43**	**26**	**35**	**86**	**69**	**97**	**49**	**90**	**21**	**7**	**7**		**3**
Aulodrilus															
Arcteonais								1	1						
Enchytraeidae	18	53	18	12	2	20	41	13	4	42	2	3			
Haemonais															
Ilyodrilus	7	3		5									1		1
Lumbriculus	10	15	8	5	27	35	23	57	37	26	19	4	3		2
Lumbriculidae						2				2					
Nais															
Rhyacodrilus															
Slavina		7													
Stylaria				1											
Tasserkidrilus															
Tubificidae	7	35	17	2	6	29	5	16	5	20			3		
Uncinais				1				10	2						
Vejdovskyella															
Hirudinea	**1**	**2**	**3**	**3**	**2**	**3**	**2**	**6**	**4**	**17**	**5**	**7**	**7**	**1**	**6**
Erpobdella	1			1		1	2	2	1	2					1
Gloiobdella				1	1						1	2	1		
Glossiphonia															
Haemopis									1						
Helobdella		2	3	1	1	2		4	1	15					4
Macrobdella									1						
Nephelopsis											4	5	4	1	1
Placobdella													2		
Caecidotea															
Amphipoda	**1341**	**914**	**1819**	**478**	**1195**	**1056**	**2486**	**3143**	**923**	**1624**	**1055**	**224**	**220**	**28**	**137**
Crangonyx	3	1	9	4	9	125	178	241	245	256	26	21	48	2	9
Diporeia															
Hyalella	1338	913	1810	474	1186	931	2308	2902	678	1368	1029	203	172	26	128
Decapoda	**1**				**1**				**1**		**2**		**1**		**1**
Cambarus									1		2		1		1
Orconectes	1				1										
Ostracoda					**7**										
Candona					4										
Cyclocypris					2										
Cypridopsis															
Darwinula					1										

	BLUE CHALK					CLEAR					CRADLE				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Hydracarina			**1**		**2**					**1**			**2**		**1**
Arrenurus										1					
Atractides															
Frontipoda															
Hydrodroma															
Hygrobates			1		2										
Koenikea															
Limnesia															
Limnochares															
Mideopsis															
Piona															
Porolohmannella													2		1
Pseudohydryphantes															
Unionicola															
Collembola					**1**										
Hypogastrura					1										
Isotomurus															
Tardigrada															
Dactylobiotus															
Ephemeroptera	**598**	**298**	**363**	**117**	**290**	**541**	**584**	**789**	**634**	**252**	**355**	**169**	**121**	**23**	**20**
Caenis	22	28	49	23	7	70	138	358	438	24	26	29	54	20	2
Cleon															
Ephemera	10	7	2	6	11										
Eurylophella	176	86	84	26	18	48	336	67	98	8	79	29	43	2	2
Hexagenia	32	2	1	3	5	5	7	1							
Leptophlebia	343	165	128	55	242	408	85	360	96	217	246	109	22	1	14
Siphloplecton					1										
Stenacron	14	8	95	4	2			1			1		1		
Stenonema	1	2	4		4	10	18	2	2	3	3	2	1		2
Odonata	**83**	**47**	**100**	**35**	**25**	**55**	**85**	**65**	**26**	**43**	**26**	**49**	**26**	**16**	**18**
Aeshna						1	2	1	2	4	3	2	1		
Argia									1						
Basiaeschna	1					1	1	1							
Boyeria		1	1				1		1						
Celithemis						1	18	2	2						
Chromagrion										1					
Cordulia			1						2		1	5	2	4	5
Didymops															
Dorocordulia															
Dromogomphus															
Enallagma	61	29	52	15	6	19	23	13	3	7	7	26		1	
Epitheca		1	5				1	1							
Gomphus	9	8	35	16	18	17	25	16	3	7	2	2			2
Hagenius	1	3	1	1	1		1	2	2		1				
Helocordulia															
Ischnura	4	1	3			4	2	16	1	11	1			1	
Lestes															
Leucorrhinia	1	1				2				1	4	7	3	1	3
Libellula	5	3	1			8	7	13	7	11	7	6	19	8	4
Macromia							1								
Nasiaeschna															
Somatochlora	1		1	1		2	3					1	1	1	4
Tetragoneuria				2					2	1					

	BLUE CHALK					CLEAR					CRADLE				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Plecoptera	1	1			2										
Isoperla	1	1													
Nemoura															
Paracapnia					2										
Soyedina															
Hemiptera		1		1	1	3				3	4	18	4		14
Belostoma															
Buenoa												1			
Cenocorixa												2			
Hesperocorixa															
Notonecta						3				3	1	1	1		
Lethocerus															
Palmacorixa															
Ranatra											1				
Sigara		1		1	1						2	14	3		14
Megaloptera				1	2	25	19	7	2	15		1	1		1
Chauliodes															
Sialis				1	2	25	19	7	2	15		1	1		1
Neuroptera															
Climacia															
Trichoptera	76	64	72	24	69	90	275	183	75	120	36	47	125	38	23
Agarodes		3	12	1	3		41	20	1	3					
Agrypnia	4				3	1		1		1		1	4		3
Banksiola				1		6	9	5	3	17	2	1			
Ceraclea									1						
Diplectrona															
Hydroptila							1		1		1				
Lepidostoma					1		6		1						
Leptoceridae	1														
Lype					3				1	1	3				
Molanna	5	3	7		6	4	28	51	4	31	1	3	5		
Mystacides	7	13	16	6	7	5	34	47	7	7	1		4	1	
Nectopsyche	2	8	6	3	1	2	6	12	16	3	1				
Nemotaulius															
Nyctiophylax			2	1	1	2	2	2	4	2	4		1		1
Oecetis	9	4	17	6	7	9	55	19	15	7	6	17	100	31	9
Orthotrichia															1
Oxyethira		1	1	1			3		1	1	1	10	5	4	1
Phryganea															
Phylocentropus													2		3
Platycentropus										1	1				1
Polycentropus	5	7	6	3	9	8	11	10	10	39	3				1
Ptilostomis		2			9		3			1	4	3	3	2	3
Pycnopsyche	37	22	4	1	19	51	71	12	6	4	5	11	1		
Triaenodes	6	1	1	1		2	5	4	4	2	3	1			
Lepidoptera	2		3		1	3	15	2	2	2	2				
Acentria															
Eoparargyractis	2		3		1	3	15	2	2	2	2				
Paraponyx															

	BLUE CHALK					CLEAR					CRADLE				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Coleoptera	**77**	**109**	**221**	**62**	**42**	**25**	**19**	7	**33**	**241**	**9**	**9**	**4**	**1**	
Agabus															
Berosus															
Coptotomus															
Cyphon															
Dineutus						2		2		1					
Donacia									1	2					
Dubiraphia	23	32	168	21	4										
Ectopria	2	3		2				2	2						
Graphoderus												1			
Gyrinus												1			
Haliplus															
Hydroporus	1	1	7		1	3	5			2	9	7	4	1	
Macronychus	3	5	15	1	1		1	1		1					
Phytosus															
Scirtes															
Stenelmis	48	68	31	38	36	20	13	2	30	235					
Tropisternus															

	BLUE CHALK					CLEAR					CRADLE				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA:TOTAL	1305	1187	1719	730	814	872	1455	1994	1476	1335	1646	682	3101	1025	1821
Diptera Ceratopogonidae	62	53	23	36	24	80	94	96	93	80	19	39	70	31	14
Alluaudomyia															
Bezzia	18	10	11	4	1	50	73	25	65	41	10	35	55	31	12
Brachypogon															
Ceratopogon	1														
Culicoides															
Dasyhelea	3	2	2	1	2	1			2	20					1
Forcipomyia															
Mallochohelea			1										3		
Monohelea									1			1	1		1
Palpomyia		1									2	1	3		
Probezzia	40	40	9	30	21	29	21	71	25	19	7	2	8		
Stilobezzia				1											
Chironomidae	1232	1131	1694	689	789	790	1358	1898	1383	1255	1627	642	3031	994	1806
Subfam.-Podonominae	1					1									
Parochlus	1					1									
Subfam.-Tanypodinae	544	634	683	413	497	151	181	390	284	158	222	74	484	212	529
Ablabesmyia	57	102	85	29	20	40	48	173	139	26	70	3	120	55	96
Clinotanypus						5			2	1	5	22	4	2	9
Conchapelopia	55	57	124	64	93	16	21	28	35	24	1		54		7
Djalmabatista	33	82	9	104	14	1		8	2	3					
Guttipelopia															
Labrundinia	1	6	3		1										
Larsia	297	305	337	163	215	1		3	4	14			2		1
Natarsia															
Paramerina															
Procladius	56	57	90	34	101	87	107	176	97	89	129	48	297	154	395
Tanypus															
Thienemannimyia	12	5	7	5	24		6	1	3						
Trissopelopia															
Zavrelimyia	33	20	28	14	29	1		1	2	1	17	1	7	1	21
Subfam.-Diamesinae															
Potthastia															
Subfam.-Prodiamesinae	3					18	6	42	1	2	1		1		
Monodiamesa	3					18	6	42	1	2	1		1		
Prodiamesa															
Subfam.-Orthocladiinae	143	67	70	52	61	54	143	76	52	55	140	110	54	87	158
Brillia					1			1		2					
Corynoneura	1	4			6				2	4				1	2
Cricotopus										2					
Diplocladius					1										
Epoicocladius	1	1													
Heterotanytarsus								1	1						
Heterotrissocladius	15	17	6	4	3	4	72	1	2	10	4	46			8
Hydrobaenus															
nr Lapposmittia				1	1										
Limnophyes	2						5								
Nanocladius															
Oliveridia															
Paracladius															
Paracricotopus								1							
Parakiefferiella	1	12	1	3	6		10	3	1	1	1		2		1
Parametriocnemus	8				1	11			3	1					
Psectrocladius	100	24	51	36	38	23	34	32	28	21	114	63	41	82	136

			BLUE CHALK					CLEAR					CRADLE		
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Subfam.-Orthocladiinae cont'd															
Pseudorthocladius															1
Pseudosmittia			1	1	1	1			2	1					
Rheocricotopus							14								
Stackelbergina						8		5	2	3	21	1	9	4	8
Stictocladius															
Synorthocladius															
Thienemanniella															
Xylotopus	3	1	1	1											2
Zalutschia	12	8	10	6	3	7	9	32	11	10			2		
Subfam.-Chironominae	541	430	941	224	231	566	1029	1390	1046	1040	1264	458	2492	695	1119
Tribe-Chironomini	346	198	261	160	137	494	823	1265	901	667	882	346	1377	505	646
Chironomus			1		1	2	9	136	22	68	6	2	151	38	26
Cladopelma									4		1		60	39	10
Cryptochironomus	20	14	8	10	10	8	8	39	22	33	3	7	14	8	5
Demicryptochironomus		2	1	1	1			2	2	2	2		1		
Dicrotendipes	86	36	69	23	14	26	69	245	76	81	65	51	213	131	147
Endochironomus			2	1	5	7		5	12	1	3		7		3
Glyptotendipes		1	2	1	1	2	6	1	3	3	5	1	3	8	2
Lauterborniella	5	15	5		1			1	3				4	9	1
Lipiniella				2											
Microtendipes	32	14	20	8	2	160	174	199	70	186	65	101	145	42	107
Nilothauma	3	3		4		1	7	2	3	2		4	14		4
Omisus															
Pagastiella		27	11	13	40	1	3	36	25	25	1		105	2	11
Paracladopelma			1												
Paratendipes	1	1	4			42		1	11	3	11	16	18	1	1
Parachironomus															
Paralauterborniella															
Phaenopsectra	8	3	7	2	1			3	13	4			15	8	11
Polypedilum	59	39	25	53	19	29	14	26	14	24	47	3	104	48	28
Pseudochironomus	5	12	87	8	12	55	95	60	13	75	2	36	2	7	3
Stenochironomus	6	2	3	1	4	1	12	2			2	2	1	3	5
Stictochironomus	11	2		13	16	141	311	402	554	92	75		36		1
Tribelos	110	27	15	20	10	19	116	103	54	68	589	123	457	138	277
Xenochironomus								2							1
Zavreliella											5		27	23	3
Tribe-Tanytarsini	195	232	680	64	94	72	205	125	145	373	382	112	1115	190	473
Cladotanytarsus	50	74	387	33	29	4	11	47	9	23	145	24	20	7	15
Paratanytarsus	18	16	22	8	1	10	14	7	1	2	1	1	9	31	17
Stempellina	14	30	99	2	2			1	1	10					
Stempellinella		4													
Tanytarsus/Micropsectra	113	108	172	21	62	58	180	70	134	338	236	87	1086	152	441
Zavrelia															
DIPTERA: Tabanidae															
Chrysops															
Tabanus															

	BLUE CHALK					CLEAR					CRADLE				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA:Tipulidae	8					1	1								
Dactylolabis															
Dicranota															
Erioptera						1									
Gonomyia	8														
Hexatoma															
Ormosia															
Pedicia							1								
Pilaria															
DIPTERA:Chaoboridae					1						1			1	
Chaoborus						1						1			1
Diptera: Misc.	3	3	2	5	1		2								
Cecidomyiidae															
Dolichopodidae							1								
Empididae.Hemerodromia	3	3	2	5	1		1								
Empididae. other genera															
Gastropoda	3	3	58		4	2	12	97	21	6	3		7		1
Amnicola	1	2	35		4			1		3					1
Campeloma															
Gyraulus	1		15												
Ferrissia	1	1	8			2	5	30	3	1	3		4		
Helicodiscus															
Helisoma															
Physella								65		2			3		
Menetus							7	1	18						
Valvata															
Pelecypoda	8	20	42	2	34	85	33	413	59	298	26	12	19		7
Musculium		1						1							
Pisidium	8	19	42	2	34	85	33	412	59	298	26	12	19		7
LAKE/YEAR	BC88	BC89	BC90	BC91	BC92	CL88	CL89	CL90	CL91	CL92	CR88	CR89	CR90	CR91	CR92
ABUNDANCE SUM	3552	2785	4458	1486	2542	2851	5058	6818	3311	4054	3190	1227	3645	1132	2053

	CROSSON					DELANO					HAMER				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Acanthocephala					**2**										
Genus indet. F92					2										
Nemertea															
Prostoma															
Coelenterata								**3**							
Hydra								**3**							
Turbellaria	**1**	**4**			**3**						**1**				
Dugesia	1	4			3						1				
Nematoda	**2**	**15**	**2**	**2**	**2**	**1**	**3**		**1**			**1**		**1**	**1**
Anatonchus		2				1									
Dorylaimus		1													
Mermithidae	2	12	**1**	1	1		3		1			1		1	1
Mononchus				1	1										
Paractinolaimus			1												
Oligochaeta	**23**	**49**	**3**	**14**	**13**	**8**	**47**	**11**	**4**	**6**	**64**	**13**	**8**	**18**	**21**
Aulodrilus		6						**1**							
Arcteonais															
Enchytraeidae	12	16	**2**	6		2	15	**1**			16	4	**1**	3	5
Haemonais										1				1	
Ilyodrilus	4	13			1									1	
Lumbriculus	4	1		7	9	4	2	**2**	3	4	18		**5**	7	13
Lumbriculidae															2
Nais		4									1			**1**	
Rhyacodrilus															
Slavina		2									1				
Stylaria											18				
Tasserkidrilus															
Tubificidae	3	4	**1**	1	3	2	30	**7**	1		10	9	**2**	4	1
Uncinais		2													
Vejdovskyella		1								1				1	
Hirudinea	**8**	**2**	**2**	**1**	**11**	**3**	**18**	**3**	**1**	**2**	**2**	**1**	**1**	**1**	**3**
Erpobdella	3		**2**	1	4		1	2	1		1		**1**		1
Gloiobdella	2	1			3			**1**		1					
Glossiphonia														1	
Haemopis															
Helobdella	3	1			2	2	16			1					1
Macrobdella						1									
Nephelopsis															
Placobdella					2		1				1	1			1
Caecidotea															
Amphipoda	**1811**	**814**	**1995**	**1370**	**3019**	**683**	**705**	**1421**	**745**	**840**	**3617**	**1531**	**1589**	**724**	**1986**
Crangonyx	21	5	**13**	71	90	25	53	**42**	22	13	64	53	**182**	99	75
Diporeia												67			
Hyalella	1790	809	**1982**	1299	2929	658	652	**1379**	723	827	3553	1411	**1407**	625	1911
Decapoda															
Cambarus															
Orconectes															
Ostracoda					**8**					**1**				**1**	
Candona					2										
Cyclocypris					6					1					
Cypridopsis														1	
Darwinula															

	CROSSON					DELANO					HAMER				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Hydracarina	1	25	2	9	9		4	10	6	7	41	16	11	2	50
Arrenurus								1		1	7	1			2
Atractides					1										
Frontipoda										1					
Hydrodroma		1		1			1		1		2				
Hygrobates		1		1											
Koenikea															
Limnesia	1		1	6	1		2		2		1	1			1
Limnochares		5									4	5	6		12
Midiopsis															
Piona															
Porolohmannella					1			2	1	1					
Pseudohydryphantes		14	1						2		2	5		2	6
Unionicola		4		1	6		1	7		4	25	4	5		29
Collembola		3												2	
Hypogastrura		3												2	
Isotomurus															
Tardigrada															
Dactylobiotus															
Ephemeroptera	805	762	405	907	1218	768	858	309	210	194	1672	1552	1283	2489	991
Caenis	338	410	22	201	16	182	249	95	70	15	59	266	148	307	63
Cleon															
Ephemera															
Eurylophella	72	73	17	48	15	43	121	35	28	3	193	203	544	161	53
Hexagenia	2	2	10	3	1			1	6						
Leptophlebia	325	269	344	643	1175	520	456	164	96	171	1415	1081	588	2021	874
Siphloplecton					1										
Stenacron	38	3	3	1	3	4	11	8	3		2	2	1		
Stenonema	30	5	9	11	7	19	21	6	7	5	3		2		1
Odonata	324	148	370	176	237	136	129	173	227	72	314	389	203	236	257
Aeshna	3			1	7	3	1	3	2	1	3	2	2	4	3
Argia								3	7		9	5		5	2
Basiaeschna	9	1	1	1	2	1		1	2	3	1	2			3
Boyeria						3				1		35			
Celithemis		49	56	1	10						50		8	14	23
Chromagrion							1			1					
Cordulia	3				7	23	20	7	11	13	21	47	9	18	22
Didymops	1		1		1										1
Dorocordulia															1
Dromogomphus	1														
Enallagma	60	22	129	39	14	20	25	13	18	2	54	93	72	73	54
Epitheca	32	11	32			10	8	10			8	10	2		
Gomphus	145	41	111	45	77	26	42	83	74	15	43	34	29	36	42
Hagenius	5	1	2	6	4	1	3		3			4	3	5	
Helocordulia									58	10					
Ischnura	43	14	25	55	73	25	12	35	28	10	51	50	57	50	26
Lestes			1								6	7	1	2	6
Leucorrhinia	3			3	1						35	18	4	2	4
Libellula	19	9	11	14	9	4	2	5	8	4	33	80	16	25	62
Macromia			1												
Nasiaeschna					3							2		1	
Somatochlora						20	15	13							
Tetragoneuria				11	29				16	12				1	8

	CROSSON					DELANO					HAMER				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Plecoptera															
Isoperla															
Nemoura															
Paracapnia															
Soyedina															
Hemiptera	1	1		1	1	1	3					22	51	13	1
Belostoma															
Buenoa															
Cenocorixa															
Hesperocorixa												16	50	2	
Notonecta	1				1	1						6		10	1
Lethocerus		1					2								
Palmacorixa															
Ranatra															
Sigara				1			1						1	1	
Megaloptera	7	6	3	2		1		2	1		2	15	5	9	20
Chauliodes	1														
Sialis	6	6	3	2		1		2	1		2	15	5	9	20
Neuroptera												1	1	1	2
Climacia												1	1	1	2
Trichoptera	142	103	240	141	528	38	132	53	83	81	406	420	308	379	648
Agarodes		10	83	15	35		2		16	1					
Agrypnia	7	2	16	2	18	3	4	2	4	1	18	15	2	16	44
Banksiola				1	5		1					3		1	16
Ceraclea						1				1					2
Diplectrona															
Hydroptila	1	2			18	2	21	4	3	7	148	141	16	3	46
Lepidostoma		1				6			2	2					
Leptoceridae															
Lype		1				1									
Molanna		2	61	3	15					1					
Mystacides	6	1	19	3	3	4		13	12	4					
Nectopsyche	67	34	10	41	16	1	4	3	6	1	4	29	166	67	36
Nemotaulius					2					1	1	3	1	1	2
Nyctiophylax	4	4	3	5	5		1	1	2		3	1			
Oecetis	27	18	8	26	14	3	10	4	13	30	2	3	17	16	90
Orthotrichia				1	3								2	1	1
Oxyethira	7	7	4	15	40		43	10	3	4	15	98	12	20	98
Phryganea					2							1			4
Phylocentropus									1	1					
Platycentropus					69	1	1			2			12	118	22
Polycentropus	5	10	22	14	241	15	10	4	10	11	211	90	43	105	259
Ptilostomis			1		12				2	1	2	8	1	25	27
Pycnopsyche	14	9	13	13	28	1	33	11	6	13	2	28	36	5	
Triaenodes	4	2		2	2		2	1	3					1	1
Lepidoptera			4					1				1			2
Acentria															2
Eoparargyractis			4					1							
Paraponyx												1			

			CROSSON					DELANO					HAMER		
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Coleoptera	**112**	**328**	**184**	**187**	**67**	**18**	**175**	**267**	**209**	**70**	**4**	**17**	**13**	**15**	**5**
Agabus							1								
Berosus															
Coptotomus														1	
Cyphon											1				
Dineutus							1				3	5	**1**	6	3
Donacia		2	**4**	8	1			**1**				10	**11**		1
Dubiraphia	92	291	**170**	153	48	9	155	**186**	195	69					
Ectopria								**2**	1						
Graphoderus															
Gyrinus					2	1									
Haliplus							3					2		1	1
Hydroporus							1			1				3	
Macronychus	7	12	**5**	13	4		9	**10**	12						
Phytosus		1													
Scirtes				1			2						**1**	4	
Stenelmis	13	22	**5**	12	12	8	3	**68**	1						
Tropisternus															

	CROSSON					DELANO					HAMER				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA: TOTAL	**1627**	**3085**	**1491**	**1323**	**4040**	**499**	**2450**	**1324**	**860**	**1721**	**1521**	**2153**	**1326**	**2526**	**3260**
Diptera Ceratopogonidae	**35**	**60**	**6**	**85**	**101**	**14**	**141**	**28**	**20**	**21**	**389**	**472**	**290**	**202**	**206**
Alluaudomyia				1											2
Bezzia	13	33	3	66	89	7	134	20	14	10	385	433	280	188	189
Brachypogon														1	
Ceratopogon															
Culicoides														1	1
Dasyhelea					1	1	2		2		3	28	5	4	4
Forcipomyia				1											
Mallochohelea													2		
Monohelea				1	1	2		1			1	4		8	10
Palpomyia	4	4					5	3				2	2		
Probezzia	18	23	3	16	10	4		4	4	11		5	1		
Stilobezzia															
Chironomidae	**1592**	**3023**	**1483**	**1231**	**3938**	**485**	**2304**	**1293**	**833**	**1696**	**1129**	**1679**	**1023**	**2307**	**3045**
Subfam.-Podonominae	**1**														
Parochlus	1														
Subfam.-Tanypodinae	**729**	**982**	**418**	**333**	**904**	**218**	**648**	**495**	**359**	**577**	**475**	**512**	**357**	**859**	**1006**
Ablabesmyia	54	263	13	46	155	18	80	37	54	65	80	124	12	276	161
Clinotanypus	5		2			1	4	11	6	5	4	34	37	31	74
Conchapelopia	47	40	62	44	124	44	71	106	66	57	104	40	122	296	188
Djalmabatista		89	36	23	27	3									
Guttipelopia				1	6		22					2	9	3	10
Labrundinia		10		1	7	1	22	15	4	3	1		7	17	8
Larsia	19	46	4	39	16	7	36	51	16	28	21	17	7	74	24
Natarsia	1							3		5			49	17	5
Paramerina															
Procladius	601	525	301	179	569	127	379	269	201	385	265	295	114	132	525
Tanypus														13	11
Thienemannimyia	2														
Trissopelopia															
Zavrelimyia		8				17	34	3	12	29					
Subfam.-Diamesinae												5	1	4	
Potthastia												5	1	4	
Subfam.-Prodiamesinae															
Monodiamesa															
Prodiamesa															
Subfam.-Orthocladiinae	**236**	**608**	**140**	**151**	**626**	**26**	**119**	**109**	**15**	**111**	**319**	**176**	**101**	**480**	**395**
Brillia					1								1	1	
Corynoneura				1	12					1	4			9	2
Cricotopus						1				2		1			
Diplocladius															
Epoicocladius															
Heterotanytarsus		14	1	1	1		1								
Heterotrissocladius		18		2	3	1	16	6		2	1			40	
Hydrobaenus				1											
nr Lapposmittia					4					2					
Limnophyes															
Nanocladius				2	7		2	8	3	1	2			6	2
Oliveridia															
Paracladius				4	3							1	2	24	5
Paracricotopus								2							
Parakiefferiella	25	86	4	6	14		2	17	2	3			6	6	22
Parametriocnemus					3	1	1		1	7			11	41	
Psectrocladius	136	293	24	34	397	20	85	43	7	82	285	135	23	271	333

			CROSSON					DELANO					HAMER		
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Subfam.-Orthocladiinae cont'd															
Pseudorthocladius															
Pseudosmittia				2	1			1		1					
Rheocricotopus															
Stackelbergina			1		1	1					24	38	57	73	26
Stictocladius															
Synorthocladius															
Thienemanniella															
Xylotopus					1		6	1		1					
Zalutschia	75	197	110	98	178	2	5	31	2	9	3	1	1	9	5
Subfam.-Chironominae	**626**	**1433**	**925**	**747**	**2408**	**241**	**1538**	**689**	**459**	**1008**	**335**	**986**	**564**	**964**	**1644**
Tribe-Chironomini	**351**	**666**	**790**	**571**	**1975**	**175**	**1064**	**494**	**360**	**710**	**306**	**919**	**515**	**849**	**1497**
Chironomus	87	29	9	64	213	23	230	13	6	92	13	11	3	17	82
Cladopelma			1		6	1	1	7	2	7		4	2	1	8
Cryptochironomus	3		5	10	16	3	31	34	7	27	3	11	40	29	48
Demicryptochironomus															
Dicrotendipes	76	252	498	120	648	25	395	131	62	98	43	48	25	81	142
Endochironomus	50	51	52	25	163	8	2	3	11	25	11	9	20	31	109
Glyptotendipes	4		6	2	3	1	3	3	6	3	8	22	5	44	25
Lauterborniella		7	1	5	17	1		4	20	2		14	31	21	16
Lipiniella															
Microtendipes	15	78	40	24	40	42	143	42	46	84	45	77	9	39	151
Nilothauma		4	1	3	5		3	7	3	2					1
Omisus					205		23				1			1	2
Pagastiella	3	7	1	4	13	1	34	115	99	88	17	78	107	163	335
Paracladopelma					2					2					5
Paratendipes	3	4		1	2		6	5	3	4	4			3	
Parachironomus						1									
Paralauterborniella															
Phaenopsectra			2	8	36	3		21	6	58	1	2	1	9	3
Polypedilum	17	73	11	31	44	6	15	18	13	22	83	147	66	167	273
Pseudochironomus	6	51	131	141	452	2	8	51	27	8	40	218	92	115	138
Stenochironomus	8	7	2	6	6	2	2		6	3	2	10	10	2	10
Stictochironomus	1		1	10	6	3		2		1	4	3	5	2	1
Tribelos	27	100	27	106	92	44	97	34	41	183	21	107	71	45	132
Xenochironomus				1	1	1	1	3				2	3	8	8
Zavreliella	51	4	2	10	5	8	70	1	2	1	10	156	25	71	8
Tribe-Tanytarsini	**275**	**767**	**135**	**176**	**433**	**66**	**474**	**195**	**99**	**298**	**29**	**67**	**49**	**115**	**147**
Cladotanytarsus	130	287	37	75	16	1	16	16	15	10	10	44	14	5	47
Paratanytarsus	4	110	13	24	3	3	60	8	1	4	6	5		37	9
Stempellina		6						1							
Stempellinella		6	1	2					2	1					
Tanytarsus/Micropsectra	141	359	84	75	414	62	399	170	81	283	13	18	35	73	91
Zavrelia															
DIPTERA: Tabanidae		**1**	**1**				**2**	**1**	**2**		**1**	**2**	**3**	**1**	**3**
Chrysops		1	1				2	1	2		1	2	3	1	3
Tabanus															

	CROSSON					DELANO					HAMER				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA: Tipulidae		1			1		3	1		3	1		10	16	5
Dactylolabis														1	
Dicranota															
Erioptera		1			1		3	1		3	1		9	7	4
Gonomyia														1	
Hexatoma													1	1	
Ormosia														1	
Pedicia															
Pilaria														5	1
DIPTERA:Chaoboridae				4											1
Chaoborus				4											1
Diptera. Misc.			1	3				1	5	1	1				
Cecidomyiidae				2											
Dolichopodidae											1				
Empididae Hemerodromia			1	1				1	5	1					
Empididae other genera															
Gastropoda	47	65	45	4	4	2	184	53	2	7	9	8	12	2	2
Amnicola	42	20	44	4	3		103	22		5					
Campeloma					1										
Gyraulus															
Ferrissia	3	5	1			1					9	5			2
Helicodiscus															
Helisoma							1								
Physella								31					12	1	
Menetus	2	40				1	80		2	2		3		1	
Valvata															
Pelecypoda	4	14	10	1	58	31	49	14	10	4	270	82	132	75	491
Musculium					2		1								
Pisidium	4	14	10	1	56	31	48	14	10	4	270	82	132	75	491
LAKE/YEAR	CN88	CN89	CN90	CN91	CN92	DO88	DO89	DO90	DO91	DO92	HR88	HR89	HR90	HR91	HR92
ABUNDANCE SUM	4915	5424	4756	4138	9220	2189	4757	3644	2359	3005	7923	6222	4943	6494	7740

	HARP					PINCHER					PLASTIC				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Acanthocephala															
Genus indet F92															
Nemertea				**8**	**8**										
Prostoma				8	8										
Coelenterata		**1**													
Hydra		1													
Turbellaria	**27**	**16**	**6**	**5**	**6**							**2**	**1**		
Dugesia	27	16	6	5	6							2	1		
Nematoda		**13**	**9**	**28**	**1**	**3**		**1**	**19**	**1**	**1**	**3**	**1**	**4**	
Anatonchus		8	5	9		2			13			2	1	2	
Dorylaimus		2													
Mermithidae		3	4	9	1	1		1	6	1	1	1		2	
Mononchus				3											
Paractinolaimus				7											
Oligochaeta	**61**	**42**	**56**	**28**	**16**	**27**	**7**	**4**	**12**	**39**	**28**	**21**	**9**	**19**	**17**
Aulodrilus			2												
Arcteonais		1													
Enchytraeidae	20	16	23	19	4	4	1	1	6	2	7	10	1	1	5
Haemonais														1	
Ilyodrilus	6	2	2	5				1			1				
Lumbriculus	23	11	13	2	9	21	6	2	4	36	16	9	5	14	8
Lumbriculidae	2										1				
Nais									1	1					
Rhyacodrilus															
Slavania		1													
Stylaria						1					2				
Tasserkidrilus		1													
Tubificidae	10	10	16	1	3	1			1		1	2	3	3	4
Uncinais															
Vejdovskyella				1											
Hirudinea	**3**	**1**	**3**	**1**	**8**	**4**	**11**	**4**	**1**	**12**	**8**	**1**	**1**	**1**	**5**
Erpobdella	2		3		3		9	1							
Gloiobdella	1				5					1	1	1			2
Glossiphonia															
Haemopis															
Helobdella				1		1	2		1	5	6		1		3
Macrobdella															
Nephelopsis		1				3		3		6					
Placobdella											1			1	
Caecidotea															
Amphipoda	**2095**	**817**	**1335**	**571**	**1585**	**448**	**733**	**367**	**155**	**612**	**343**	**106**	**348**	**381**	**612**
Crangonyx	5	4	4	1	6	79	658	251	65	233	4		8	7	24
Diporeia															
Hyalella	2090	813	1331	570	1579	369	75	116	90	379	339	106	340	374	588
Decapoda															
Cambarus															
Orconectes															
Ostracoda				**3**	**9**										
Candona				3	5										
Cyclocypris															
Cypridopsis					4										
Darwinula															

	HARP					PINCHER					PLASTIC				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Hydracarina		**10**	**13**	**23**	**44**				**4**		**2**			**1**	**4**
Arrenurus		1									1			1	1
Atractides															
Frontipoda															
Hydrodroma		1	3	2	1						1				2
Hygrobates		1	1	2	1										
Koenikea															
Limnesia		1	1		1										
Limnochares															
Midiopsis				1	1										
Piona									2						
Porolohmannella															1
Pseudohydryphantes															
Unionicola		6	8	18	40				2						
Collembola									**1**						
Hypogastrura															
Isotomurus									1						
Tardigrada				**16**											
Dactylobiotus				16											
Ephemeroptera	**324**	**147**	**306**	**121**	**158**	**451**	**930**	**420**	**357**	**388**	**263**	**49**	**32**	**102**	**222**
Caenis	18	39	113	69	12									1	
Cleon															
Ephemera															
Eurylophella	21	32	90	9	16	11	126	27	7	1	4	2	3	1	1
Hexagenia		1	3	1											
Leptophlebia	239	72	87	37	117	440	804	393	350	387	258	47	29	100	221
Siphloplecton	1			1	1										
Stenacron	17		3	2	1						1				
Stenonema	28	3	10	2	11										
Odonata	**346**	**122**	**265**	**205**	**160**	**31**	**546**	**101**	**398**	**115**	**118**	**38**	**58**	**138**	**66**
Aeshna					2	2	6	3	4	20	3			1	
Argia															
Basiaeschna	3	1	2		1						1				
Boyeria	1				1										
Celithemis				3							10	5	7	37	5
Chromagrion							8	10	12		4		1		
Cordulia		1		1		2	13	9	33	36		2		4	1
Didymops	2													1	
Dorocordulia															
Dromogomphus															
Enallagma	147	71	161	168	61	5	54	8	110	4	13	10		1	4
Epitheca	21	4	23								7	1	2		
Gomphus	162	36	68	18	49		14		2	5	10	5	11	15	6
Hagenius	6	2	5	4	8	4									1
Helocordulia														2	
Ischnura	3	6		4	14						57	14	26	34	16
Lestes							4								
Leucorrhinia			1			13	399	56	210	39	4		5	14	18
Libellula	1		1			5	48	13	24	10	9	1	6	24	7
Macromia		1	4												
Nasiaeschna															
Somatochlora								2	2	1					1
Tetragoneuria				7	24				1					5	7

	HARP					PINCHER					PLASTIC				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Plecoptera	1														
Isoperla	1														
Nemoura															
Paracapnia															
Soyedina															
Hemiptera	1		2	7	2	6	93	11	6	18			2	3	
Belostoma														2	
Buenoa						1	2			1					
Cenocorixa															
Hesperocorixa			2	1	2		7	1					1		
Notonecta						3	62	7	4	15				1	
Lethocerus													1		
Palmacorixa															
Ranatra															
Sigara	1			6		2	22	3	2	2					
Megaloptera	3		5	3	2	1			1						
Chauliodes															
Sialis	3		5	3	2	1			1						
Neuroptera															
Climacia															
Trichoptera	77	57	63	71	76	71	608	170	175	279	113	39	88	127	260
Agarodes		7	21	2	6							5	9	2	
Agrypnia	12	1		2		3	2		2	2	4	3	1	13	30
Banksiola						39	95	24	42	17			1	8	49
Ceraclea											1				
Diplectrona		1													
Hydroptila											6	3	6	1	6
Lepidostoma	2	2			4										
Leptoceridae															
Lype			1							4	2				
Molanna	6	3	11	2	7	1	1	4		2					1
Mystacides	6	11	5	7	4		2								
Nectopsyche	3	8	5	13	1		23	12	25	2	1	4	3	7	16
Nemotaulius					1		8			2				1	1
Nyctiophylax	2				2		1	1		2	3	1	3		1
Oecetis		10	5	35	7	4	30	18	23	10	49	12	36	68	30
Orthotrichia															
Oxyethira		6					290	20	13	5	6	5	11	4	72
Phryganea															
Phylocentropus	4										3		1		
Platycentropus					2	2	12	17	8	41			1		15
Polycentropus	14	2	7	7	22	13	104	61	53	172	28	3	13	18	27
Ptilostomis		1		1	2	5	8	2	2	8		1		5	12
Pycnopsyche	25	1	2		16	4	32	9		12	10	2	3		
Triaenodes	3	4	6	2	2			2	7						
Lepidoptera	4	2	1				1				1		2	3	
Acentria															
Eoparargyractis	4	2	1				1				1		2	3	
Paraponyx															

	HARP					PINCHER					PLASTIC				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Coleoptera	**29**	**85**	**113**	**81**	**59**	**8**	**29**	**6**	**2**	**1**	**1**		**1**	**1**	
Agabus							2								
Berosus															
Coptotomus						1	2								
Cyphon											1				
Dineutus						7	13	6	1						
Donacia													1	1	
Dubiraphia	7	83	75	71	39										
Ectopria	1		1												
Graphoderus							1								
Gyrinus							4		1						
Haliplus															
Hydroporus					1		7			1					
Macronychus	2	1	2	4											
Phytosus															
Scirtes															
Stenelmis	19	1	35	6	19										
Tropisternus															

	HARP					PINCHER					PLASTIC				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA:TOTAL	1043	1180	1081	1678	814	1641	5645	1948	5707	4633	2224	1544	1192	1666	1974
Diptera Ceratopogonidae	59	107	52	177	24	57	275	48	252	102	70	79	110	247	177
Alluaudomyia		1			1										
Bezzia	4	15	1	29	5	43	266	48	249	101	67	67	109	214	169
Brachypogon															
Ceratopogon	2	2													
Culicoides														1	
Dasyhelea	11		5	67	4						1	1	1	23	1
Forcipomyia															
Mallochohelea			2	16	3										
Monohelea						1			2					1	5
Palpomyia	1	1													
Probezzia	41	88	44	65	11	13	9		1	1	2	11		8	2
Stilobezzia															
Chironomidae	983	1071	1028	1498	790	1583	5365	1898	5451	4527	2150	1465	1073	1408	1791
Subfam.-Podonominae															
Parochlus															
Subfam.-Tanypodinae	456	230	421	608	417	445	695	341	1700	1227	482	358	185	442	451
Ablabesmyia	10	13	10	12	21	42	104	27	327	104	127	163	28	106	62
Clinotanypus	6	2		2	1	1		1	1		40	16	17	25	19
Conchapelopia	161	23	100	56	161	29	77	11	50	60	135	27	76	182	197
Djalmabatista	38	15	10	52											
Guttipelopia															
Labrundinia				3					19	1		3		1	
Larsia	122	94	217	401	182				19		7	6	7	3	1
Natarsia															1
Paramerina				1	1										
Procladius	114	80	84	75	45	357	495	293	1262	1041	173	143	57	125	163
Tanypus															
Thienemannimyia	5	3		6	4										
Trissopelopia															
Zavrelimyia					2	16	19	9	22	21					8
Subfam.-Diamesinae															
Potthastia															
Subfam.-Prodiamesinae	24	29	6	5	6										
Monodiamesa	24	29	6	5	6										
Prodiamesa															
Subfam.-Orthocladiinae	69	129	38	316	106	217	1183	226	605	431	381	353	188	148	307
Brillia					1										
Corynoneura					2					2	2				
Cricotopus				1										1	
Diplocladius															
Epoicocladius		1													
Heterotanytarsus														1	
Heterotrissocladius		8		7	9							5	12	1	
Hydrobaenus															
nr Lapposmittia															
Limnophyes															
Nanocladius				6											
Oliveridia				1											
Paracladius									1						
Paracricotopus															
Parakiefferiella		14	4	162	35		8		22	1		5	5	13	7
Parametriocnemus	1				3				2	1					1
Psectrocladius	4	21	11	74	42	114	950	153	475	349	212	190	147	62	261

	HARP					PINCHER					PLASTIC				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Subfam.-Orthocladiinae cont'd															
Pseudorthocladius															
Pseudosmittia	4	1		3	1										
Rheocricotopus															
Stackelbergina						70	123	69	52	72	27	6	3	5	10
Stictocladius															
Synorthocladius		1													
Thienemanniella															
Xylotopus					1						1				
Zalutschia	60	83	23	62	12	33	102	4	53	6	139	147	21	65	28
Subfam.-Chironominae	434	683	563	569	261	921	3487	1331	3146	2869	1287	754	700	818	1033
Tribe-Chironomini	292	441	358	317	186	698	2341	1135	2319	2106	885	495	500	660	793
Chironomus						74	487	397	739	859	65	23	11	27	152
Cladopelma		1				3			76	1	1	20	5	7	2
Cryptochironomus	2	16	12	9	4	25	31	4	40	7	50	36	44	34	23
Demicryptochironomus	1		1		1										
Dicrotendipes	44	62	68	40	32	134	858	82	516	508	154	73	26	82	134
Endochironomus	14	6	5	3	10		42	43	26	11	35		1	9	20
Glyptotendipes	3	3			5			2	2	7	32	20	5	36	25
Lauterborniella		4	3	20	1		8		30	5	7	14	41	50	23
Lipiniella															
Microtendipes	4	8	34	1	17	93	324	380	159	143	320	126	79	120	198
Nilothauma	1	4	10	9				1	23	2	1	4		4	3
Omisus					1		23	7	81	62					
Pagastiella	15	107	120	130	25	12	22	3	65	2	1	2			16
Paracladopelma				4	3				5						1
Paratendipes			7	1					2	1		3	30	31	4
Parachironomus		1													
Paralauterborniella		6													
Phaenopsectra		1	4	3	10	2	53	21	9	40		1		36	1
Polypedilum	6	98	38	50	14	15	122	7	361	31	46	41	47	27	26
Pseudochironomus	192	109	48	14	52	37	296	83	119	38	57	27	54	60	28
Stenochironomus	3			1	2	4	8	7	4	4	4	1	4	13	13
Stictochironomus	4	10		6		46			3				2		
Tribelos	3	1	8	20	9	253	51	96	22	385	110	103	146	120	121
Xenochironomus		3		6				2	37			1	1	1	2
Zavreliella		1					19				2		4	3	1
Tribe-Tanytarsini	142	242	205	252	75	223	1146	196	827	763	402	259	200	158	240
Cladotanytarsus	76	162	185	212	24	37	81	3	133	13	53	124	49	50	29
Paratanytarsus		16	1	7	6	2	49		13	4	16	27	15	30	18
Stempellina	4	3	1	1	2								1	2	
Stempellinella		1		4	4				1						
Tanytarsus/Micropsectra	62	60	18	28	39	184	1016	193	680	746	333	108	135	76	193
Zavrelia															
DIPTERA:Tabanidae		2				1	4	2	1						1
Chrysops		2				1	4	2	1						1
Tabanus															

	HARP					PINCHER					PLASTIC				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA:Tipulidae	1										3		7	11	4
Dactylolabis															
Dicranota															
Erioptera	1												7	10	4
Gonomyia											2				
Hexatoma											1				
Ormosia															
Pedicia															
Pilaria														1	
DIPTERA:Chaoboridae									2	4	1		1		
Chaoborus									2	4	1		1		
Diptera: Misc.			1	3			1		1				1		1
Cecidomyiidae															
Dolichopodidae															
Empididae:Hemerodromia		1	3			1		1				1		1	
Empididae: other genera															
Gastropoda	92	231	163	142	69	2	4	2	1	1	10	11	2		2
Amnicola	84	224	147	137	46										
Campeloma		4													
Gyraulus															
Ferrissia	5		4	3	2	2	4	2		1	10	10	2		2
Helicodiscus															
Helisoma	1		3	2	21										
Physella			1												
Menetus	2	3										1			
Valvata			8						1						
Pelecypoda	227	97	84	17	70	115	121	49	76	251	193	192	76	19	91
Musculium	17				14										
Pisidium	210	97	84	17	56	115	121	49	76	251	193	192	76	19	91
LAKE/YEAR	HP88	HP89	HP90	HP91	HP92	PN88	PN89	PN90	PN91	PN92	PC88	PC89	PC90	PC91	PC92
ABUNDANCE SUM	4333	2821	3505	3008	3087	2808	8728	3083	6915	6350	3305	2006	1813	2465	3253

	SKIDWAY					WESTWARD					YOUNG				
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Acanthocephala															
Genus indet. F92															
Nemertea														16	32
Prostoma														16	32
Coelenterata															
Hydra															
Turbellaria						8	51	6				17	10	2	8
Dugesia						8	51	6				17	10	2	8
Nematoda		1				2	47	25	13	4	4	10	1	2	1
Anatonchus						2	46	25	11	3	2	7		1	
Dorylaimus															
Mermithidae		1					1		2		2	3	1	1	1
Mononchus															
Paractinolaimus										1					
Oligochaeta	8	3	4	25	25	89	216	483	191	53	23	145	52	154	53
Aulodrilus															
Arcteonais							2								
Enchytraeidae	3			2	5	29	183	407	158	28	7	28	14	65	3
Haemonais															
Ilyodrilus		1		6	2	9	2	8		2	3				
Lumbriculus	4	2	4	10	18	44	17	45	11	11	7	26	4	79	38
Lumbriculidae	1			4		4	2		1	1	3	3	4		3
Nais							2	17	1			88			1
Rhyacodrilus										8					
Slavina						1	1								
Stylaria														1	1
Tasserkidrilus															
Tubificidae				2			7	6	20	3	3		30	9	7
Uncinais						2									
Vejdovskyella				1											
Hirudinea	115	25	11	4	11	16	1	8	18	3	9	4	5		3
Erpobdella		1	2	4	7	1	1	2		1	3	3	3		
Gloiobdella						6			7		2		2		1
Glossiphonia											1				2
Haemopis			1												
Helobdella					2	4		6	9	2	3	1			
Macrobdella						1									
Nephelopsis					1	3			2						
Placobdella					1	1									
Isopoda	115	24	8												
Caecidotea	115	24	8												
Amphipoda	311	109	100	27	83	1312	620	1161	894	601	1980	3434	970	2192	2870
Crangonyx	260	97	96	26	81	113	29	169	43	84	21	40	10	70	20
Diporeia															
Hyalella	51	12	4	1	2	1199	591	992	851	517	1959	3394	960	2122	2850
Decapoda							1			1	1	1	1	1	
Cambarus							1			1					
Orconectes											1	1	1	1	
Ostracoda															
Candona															
Cyclocypris															
Cypridopsis															
Darwinula															

	SKIDWAY					WESTWARD					YOUNG				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Hydracarina	5		1	3	6			1			1	1		3	2
Arrenurus	1										1	1		1	
Atractides															
Frontipoda															
Hydrodroma															
Hygrobates														2	
Koenikea															
Limnesia	4			2											
Limnochares					1										
Midiopsis															
Piona			1												1
Porolohmannella								1							
Pseudohydryphantes															
Unionicola				1	5										1
Collembola															
Hypogastrura															
Isotomurus															
Tardigrada															
Dactylobiotus															
Ephemeroptera	1582	444	955	505	447	417	774	684	104	209	118	270	38	265	82
Caenis	133	109	787	345	44	85	189	188	33	12	11	69	4	8	2
Cleon											1				
Ephemera											16	12	17	3	
Eurylophella	54	22	24	7	11	268	520	415	51	133	8	25		30	8
Hexagenia										1	1	1	2	2	
Leptophlebia	1393	313	144	153	392	55	53	81	16	63	75	139	13	219	70
Siphloplecton												5	2		1
Stenacron	2					4	8		2			2		1	
Stenonema						5	4		2		6	17		2	1
Odonata	264	179	138	139	72	31	19	11	32	19	67	200	85	168	93
Aeshna	6		1		1		1	1	2	4					1
Argia															
Basiaeschna	2		2	2	3	1					1			2	
Boyeria													1		
Celithemis	2		3	4											
Chromagrion															
Cordulia	18	11	13	9	19			1	1	1					1
Didymops															
Dorocordulia															
Dromogomphus											3	2	2	3	3
Enallagma	80	20	22	13	1	26	11	3	9	5	46	163	69	149	70
Epitheca	12	10	3								6	10			
Gomphus	1	1	4	5	6	3	5	5	19	8	6	20	12	10	11
Hagenius				1	1										
Helocordulia															
Ischnura	55	97	48	42	9						4	4	1	2	3
Lestes	2	1	1												
Leucorrhinia	34	4	10	12	1						1				
Libellula	52	35	31	34	23	1									2
Macromia															
Nasiaeschna												1			
Somatochlora							2	1	1	1					
Tetragoneuria				17	8									2	2

	SKIDWAY					WESTWARD					YOUNG				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
Plecoptera						2					1			5	
Isoperla															
Nemoura											1			1	
Paracapnia														4	
Soyedina						2									
Hemiptera	26	5	2	2	4	7	6		2	2					
Belostoma															
Buenoa															
Cenocorixa	1														
Hesperocorixa	21	2	1												
Notonecta	3				1	5	6			1					
Lethocerus				2	2										
Palmacorixa															
Ranatra	1														
Sigara		3	1		1	2			2	1					
Megaloptera	12	2	4	26	16	1	7	4	2	2	1	3	4		2
Chauliodes	2														
Sialis	10	2	4	26	16	1	7	4	2	2	1	3	4		2
Neuroptera															
Climacia															
Trichoptera	496	156	203	241	266	38	41	119	26	83	52	128	70	197	81
Agarodes							1	4	1	14		25	15	11	11
Agrypnia	57	10	16	23	14	2				1	2			1	3
Banksiola	1			4	8		5	2							
Ceraclea															
Diplectrona															
Hydroptila		3	1	5	8										
Lepidostoma							1	4				2		4	
Leptoceridae												4			
Lype						1								2	
Molanna						1	2		1	3	11	12	8	27	4
Mystacides								1		1	9	13	4	27	17
Nectopsyche	6	4		14	2	5	7	17	1			1			1
Nemotaulius	3														
Nyctiophylax	4	2		2	3		1	1							
Oecetis	10	4	22	40	40	10	13	21	14	11	14	31	19	81	18
Orthotrichia	1		1												
Oxyethira	67	21	3	2	2							4	1		
Phryganea	1		3	2											1
Phylocentropus			35					1			2	2	2	5	4
Platycentropus	39	25		6	27									1	2
Polycentropus	239	45	55	134	149		1			10	2	4	18	7	5
Ptilostomis			2	2	5	1	1			2	3			4	2
Pycnopsyche	65	40	65	6	8	12	8	48	1	24	6	25		23	13
Triaenodes	3	2		1		6	1	20	8	17	3	5	3	4	
Lepidoptera	4			1		3	12	7	8		2	7	45	10	
Acentria	4														
Eoparargyractis						3	12	7	8		2	7	45	10	
Paraponyx				1											

			SKIDWAY					WESTWARD					YOUNG		
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Coleoptera	**27**	**2**	**1**	**4**	**1**	**25**	**83**	**48**	**43**	**32**	**11**	**242**	**133**	**146**	**49**
Agabus															
Berosus						1					1	31	62	16	3
Coptotomus															
Cyphon															
Dineutus	3	1				3		1	1		3	3	1	2	3
Donacia		1		3											
Dubiraphia			1								3	55	23	18	13
Ectopria							1	1				2			
Graphoderus															
Gyrinus	1														
Haliplus											1	4		1	
Hydroporus	19				1	1	10			2					
Macronychus												19	6	3	
Phytosus															
Scirtes												1		2	
Stenelmis	2			1		20	72	46	42	30	3	127	41	104	30
Tropisternus	2														

	SKIDWAY					WESTWARD					YOUNG				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA:TOTAL	6040	4451	3176	2944	5821	1155	3728	5104	4733	1478	649	2647	1014	1072	449
Diptera Ceratopogonidae	414	269	168	248	222	124	421	1103	2355	50	21	104	158	82	33
Alluaudomyia														1	
Bezzia	408	267	165	244	217	30	93	56	64	17	12	29	103	32	25
Brachypogon															
Ceratopogon						1									
Culicoides					1	4				3			2		
Dasyhelea	1	1		3	1	81	299	1017	2273	15		4	33	8	4
Forcipomyia						1									
Mallochohelea															
Monohelea		1	3	1	1					1					
Palpomyia							1				1				
Probezzia	5				2	7	28	30	18	14	8	71	20	37	4
Stilobezzia														4	
Chironomidae	5620	4181	3008	2689	5598	1024	3307	3998	2348	1422	625	2541	855	987	414
Subfam.-Podonominae															
Parochlus															
Subfam.-Tanypodinae	956	630	528	1227	1725	262	191	497	252	350	327	867	197	174	150
Ablabesmyia	331	132	11	82	236	89	57	226	86	169	32	50	3	25	30
Clinotanypus						5	1	4		1	11	29	8	17	9
Conchapelopia	239	53	13	63	179	49	1	58	28	106	54	78	24	23	53
Djalmabatista									1		62	63	11	20	10
Guttipelopia	29	12	65	52	16										
Labrundinia	2				1					1					
Larsia	93	57	5	9	25	5	3	8	2	11	71	209	49	40	21
Natarsia	100	23	10	5	13					1			3		1
Paramerina															
Procladius	162	353	424	1016	1254	96	129	185	135	40	97	430	99	45	22
Tanypus															
Thienemannimyia						5		6				7			
Trissopelopia														1	
Zavrelimyia					1	13	1	10		21				3	4
Subfam.-Diamesinae											3	1		1	1
Potthastia											3	1		1	1
Subfam.-Prodiamesinae					5	4	7	14	9	3		1	5	2	
Monodiamesa						5	4	7	14	9	3		1	3	1
Prodiamesa														2	1
Subfam.-Orthocladiinae	575	398	121	245	223	41	113	118	73	169	5	185	8	161	39
Brillia	2														1
Corynoneura	10		2		2	1	5	2	2	17					
Cricotopus	4													1	
Diplocladius														16	
Epoicocladius											1			1	
Heterotanytarsus															
Heterotrissocladius						17	21	4	4	57		37	1	54	4
Hydrobaenus														25	
nr Lapposmittia															
Limnophyes												1			
Nanocladius															
Oliveridia															
Paracladius		7	1												
Paracricotopus															
Parakiefferiella					4		39	84	55	6				3	1
Parametriocnemus					2	1	1		1	7				2	2
Psectrocladius	490	391	113	238	195	6	8	21	9	63	1	77	1	50	23

			SKIDWAY					WESTWARD					YOUNG		
	YEAR					YEAR					YEAR				
	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992	1988	1989	1990	1991	1992
TAXONOMIC NAME															
Subfam.-Orthocladiinae cont'd															
Pseudorthocladius	3									7				1	
Pseudosmittia						1				2					
Rheocricotopus															
Stackelbergina	45		5	6	18	12		1		3	1			1	1
Stictocladius										1					
Synorthocladius							1								
Thienemanniella							12	1							
Xylotopus						1	1	1		1	2				
Zalutschia	21			1	2	2	25	4	2	5		71	6	7	7
Subfam.-Chironominae	**4089**	**3153**	**2359**	**1217**	**3650**	**716**	**2999**	**3376**	**2009**	**894**	**287**	**1488**	**649**	**646**	**222**
Tribe-Chironomini	**3822**	**2705**	**2228**	**1014**	**3036**	**376**	**1564**	**1222**	**745**	**519**	**231**	**522**	**314**	**291**	**132**
Chironomus	1632	710	223	113	113	24	9	223	58	165					
Cladopelma	1		3	5	2		4	2	3	1				1	
Cryptochironomus	4	7	2	6	110	24	16	42	41	18	11	53	14	49	16
Demicryptochironomus						1			1		3	2	10	4	3
Dicrotendipes	344	54	492	42	307	111	583	442	178	159	6	49	38	21	17
Endochironomus	373	54	139	51	180	1				4	29			4	2
Glyptotendipes	6		7	3	9	4	16	11	3	2	3	56	3	4	6
Lauterborniella	98	69	5	16	11	1	1	11	9	4					
Lipiniella															
Microtendipes	394	457	193	48	431	132	327	98	63	54	33	17	2	35	8
Nilothauma	38	26	3	4	10	4	5	23	18	2		17	18	4	
Omisus	90	420	124	47	64										
Pagastiella								7	1		26	30	26	33	12
Paracladopelma															
Paratendipes	4					5	42	26	35	5	4		9	4	2
Parachironomus	1														
Paralauterborniella														1	
Phaenopsectra	16		14	16	32	5	19	14	37	24				6	1
Polypedilum	619	107	36	84	108	7	22	32	14	20	11	54	37	57	20
Pseudochironomus	6		1	9	12	23	171	124	93	34	28	213	94	48	33
Stenochironomus	8		3	6	7	1	1	5		1	4	3			2
Stictochironomus	2					17	328	137	188	10	49	27	14	15	8
Tribelos	156	688	973	506	1640	16	20	25	3	16	17	1	48	5	2
Xenochironomus				11									1		
Zavreliella	30	113	10	47							7	1			
Tribe-Tanytarsini	**267**	**448**	**131**	**203**	**614**	**340**	**1435**	**2154**	**1264**	**375**	**56**	**966**	**335**	**355**	**90**
Cladotanytarsus	8	8	6	32	78	54	431	731	438	49	10	739	312	177	12
Paratanytarsus	18	5	1		1	30	305	400	455	42	1		2	2	
Stempellina						1	24	390	147		2	1	3	127	3
Stempellinella							6	3	1	3		5		1	1
Tanytarsus/Micropsectra	241	435	124	171	535	254	670	630	223	281	43	221	18	48	74
Zavrelia						1									
DIPTERA:Tabanidae	**1**	**1**									**1**				
Chrysops		1									1				
Tabanus	1														

	SKIDWAY					WESTWARD					YOUNG				
	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992	YEAR 1988	1989	1990	1991	1992
TAXONOMIC NAME															
DIPTERA: Tipulidae	**3**				**1**					**2**	**2**	**1**		**1**	**2**
Dactylolabis															
Dicranota										1					
Erioptera											2	1		1	1
Gonomyia															
Hexatoma															
Ormosia															1
Pedicia	3														
Pilaria					1					1					
DIPTERA: Chaoboridae				7						**1**				**2**	
Chaoborus				7						1				2	
Diptera: Misc.	**2**					7		**3**	**30**	**3**		**1**	**1**		
Cecidomyiidae															
Dolichopodidae	2					1									
Empididae Hemerodromia						5		3	30	3		1	1		
Empididae: other genera						1									
Gastropoda					**2**	5	16	**64**	55	5	96	**156**	97	**187**	**151**
Amnicola						2	10	**31**	55		70	131	**89**	169	145
Campeloma											4	1	**1**	2	1
Gyraulus															
Ferrissia					2	3	6	**33**		5		2			
Helicodiscus															
Helisoma											12	3	**4**	1	4
Physella											3	4	**3**	1	1
Menetus											7	15		14	
Valvata															
Pelecypoda	**6**	**58**	**2**	**71**	**54**	**217**	**566**	**1026**	**1177**	**108**	**231**	**56**	**17**	**325**	**402**
Musculium															
Pisidium	6	58	2	71	54	217	566	1026	1177	108	231	56	17	325	402
LAKE/YEAR	SY88	SY89	SY90	SY91	SY92	WD88	WD89	WD90	WD91	WD92	YG88	YG89	YG90	YG91	YG92
ABUNDANCE SUM	8896	5435	4597	3992	6808	3328	6188	8751	7298	2600	3246	7321	2542	4745	4278

APPENDIX 7

FALL 1988 - 1992 BENTHIC SUMMARY

BY TAXONOMIC ORDER OR SUB-FAMILY

BLUE CHALK

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria		1	1		1
Nematoda	2	2	2	2	1
Dorylaimina					
Enoplida	1	1	1	1	1
Mononchida	1	1	1	1	
Oligochaeta	4	5	3	6	3
Haplotaxida	2	3	1	4	1
Lumbriculida	1	1	1	1	1
Tubificida	1	1	1	1	1
Hirudinea	1	1	1	3	2
Gnathobdellida					
Pharyngobdellida	1			1	
Rhynochobdellida		1	1	2	2
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda	1				1
Ostracoda					3
Hydracarina			1		1
Collembola					1
Tardigrada					
Ephemeroptera	7	7	7	6	8
Odonata	8	8	9	5	3
Plecoptera	1	1			1
Hemiptera		1		1	1
Megaloptera				1	1
Neuroptera					
Trichoptera	9	10	10	10	12
Lepidoptera	1		1		1
Coleoptera	5	5	4	4	4
DIPTERA	41	40	39	38	41
Diptera Ceratopogonidae	4	4	4	4	3
Diptera Chironomidae	35	35	34	33	37
Sub-family Podonominae	1				
Sub-family Tanypodinae	8	8	8	7	8
Sub-family Diamesinae					
Sub-family Prodiamesinae	1				
Sub-family Orthocladiinae	9	7	6	7	10
Sub-family Chironominae	16	20	20	19	19
Tribe Chironomini	12	15	16	15	15
Tribe Tanytarsini	4	5	4	4	4
Diptera Tabanidae					
Diptera Tipulidae	1				
Diptera Chaoboridae					
Diptera Misc	1	1	1	1	1
Gastropoda	3	2	3		1
Basomatophora	2	1	2		
Mesogastrophora	1	1	1		1
Pelecypoda	1	2	1	1	1
LAKE/YEAR	BC88	BC89	BC90	BC91	BC92
GENERA SUM	86	87	84	80	91

BLUE CHALK

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria		7	7		14
Nematoda	14	19	7	7	1
Dorylaimina					
Enoplida	6	6	1	6	1
Mononchida	8	13	6	1	
Oligochaeta	42	113	43	26	35
Haplotaxida	25	63	18	19	2
Lumbriculida	10	15	8	5	27
Tubificida	7	35	17	2	6
Hirudinea	1	2	3	3	2
Gnathobdellida					
Pharyngobdellida	1			1	
Rhynochobdellida	2	3	2	2	
Isopoda					
Amphipoda	1341	914	1819	478	1195
Decapoda	1				1
Ostracoda				7	
Hydracarina			1		2
Collembola					1
Tardigrada					
Ephemeroptera	598	298	363	117	290
Odonata	83	47	100	35	25
Plecoptera	1	1			2
Hemiptera	1		1	1	
Megaloptera				1	2
Neuroptera					
Trichoptera	76	64	72	24	69
Lepidoptera	2		3		1
Coleoptera	77	109	221	62	42
DIPTERA	1305	1187	1719	730	814
Diptera Ceratopogonidae	62	53	23	36	24
Diptera Chironomidae	1232	1131	1694	689	789
Sub-family Podonominae	1				
Sub-family Tanypodinae	544	634	683	413	497
Sub-family Diamesinae					
Sub-family Prodiamesinae	3				
Sub-family Orthocladiinae	143	67	70	52	61
Sub-family Chironominae	541	430	941	224	231
Tribe Chironomini	346	198	261	160	137
Tribe Tanytarsini	195	232	680	64	94
Diptera Tabanidae					
Diptera Tipulidae	8				
Diptera Chaoboridae					
Diptera Misc	3	3	2	5	1
Gastropoda	3	3	58		4
Basomatophora	2	1	23		
Mesogastrophora	1	2	35		4
Pelecypoda	8	20	42	2	34
LAKE/YEAR	BC88	BC89	BC90	BC91	BC92
ABUNDANCE SUM	3552	2785	4458	1486	2542

	CLEAR				
LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda	2	2	1	2	2
Dorylaimina					
Enoplida	1	1		1	1
Mononchida	1	1	1	1	1
Oligochaeta	4	3	5	5	4
Haplotaxida	1	1	3	3	1
Lumbriculida	2	1	1	1	2
Tubificida	1	1	1	1	1
Hirudinea	2	1	2	4	2
Gnathobdellida				2	
Pharyngobdellida	1	1	1	1	1
Rhynochobdellida	1		1	1	1
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda				1	
Ostracoda					
Hydracarina					1
Collembola					
Tardigrada					
Ephemeroptera	5	5	6	4	4
Odonata	9	12	9	11	8
Plecoptera					
Hemiptera	1				1
Megaloptera	1	1	1	1	1
Neuroptera					
Trichoptera	10	14	11	15	15
Lepidoptera	1	1	1	1	1
Coleoptera	3	3	4	3	5
DIPTERA	37	31	40	43	40
Diptera Ceratopogonidae	3	2	2	4	3
Diptera Chironomidae	32	26	38	39	37
Sub-family Podonominae	1				
Sub-family Tanypodinae	7	4	7	8	7
Sub-family Diamesinae					
Sub-family Prodiamesinae	1	1	1	1	1
Sub-family Orthocladinae	6	6	8	9	10
Sub-family Chironominae	17	15	22	21	19
Tribe Chironomini	14	12	18	17	15
Tribe Tanytarsini	3	3	4	4	4
Diptera Tabanidae					
Diptera Tipulidae	1	1			
Diptera Chaoboridae	1				
Diptera. Misc.		2			
Gastropoda	1	2	4	2	3
Basomatophora	1	2	3	2	2
Mesogastrophora			1		1
Pelecypoda	1	1	2	1	1
LAKE/YEAR	CL88	CL89	CL90	CL91	CL92
GENERA SUM	79	78	89	96	90

	CLEAR				
LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda	5	4	15	6	7
Dorylaimina					
Enoplida	1	3		2	5
Mononchida	4	1	15	4	2
Oligochaeta	86	69	97	49	90
Haplotaxida	20	41	24	7	42
Lumbriculida	37	23	57	37	28
Tubificida	29	5	16	5	20
Hirudinea	3	2	6	4	17
Gnathobdellida				2	
Pharyngobdellida	1	2	2	1	2
Rhynochobdellida	2		4	1	15
Isopoda					
Amphipoda	1056	2486	3143	923	1624
Decapoda			1		
Ostracoda					
Hydracarina					1
Collembola					
Tardigrada					
Ephemeroptera	541	584	789	634	252
Odonata	55	85	65	26	43
Plecoptera					
Hemiptera	3				3
Megaloptera	25	19	7	2	15
Neuroptera					
Trichoptera	90	275	183	75	120
Lepidoptera	3	15	2	2	2
Coleoptera	25	19	7	33	241
DIPTERA	872	1455.3	1994	1476	1335
Diptera Ceratopogonidae	80	94	96	93	80
Diptera Chironomidae	790	1358 3	1898	1383	1255
Sub-family Podonominae	1				
Sub-family Tanypodinae	151	181	390	284	158
Sub-family Diamesinae					
Sub-family Prodiamesinae	18	6	42	1	2
Sub-family Orthocladinae	54	143	76	52	55
Sub-family Chironominae	566	1028.8	1390	1046	1040
Tribe Chironomini	494	823	1265	901	667
Tribe Tanytarsini	72	205	125	145	373
Diptera Tabanidae					
Diptera Tipulidae	1	1			
Diptera Chaoboridae	1				
Diptera: Misc.		2			
Gastropoda	2	12	97	21	6
Basomatophora	2	12	96	21	3
Mesogastrophora			1		3
Pelecypoda	85	33	413	59	298
LAKE/YEAR	CL88	CL89	CL90	CL91	CL92
ABUNDANCE SUM	2851	5058 3	6818	3311	4054

CRADLE

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda	1				
Dorylaimina					
Enoplida					
Mononchida		1			
Oligochaeta	2	2	3		2
Haplotaxida	1	1	1		1
Lumbriculida	1	1	1		1
Tubificida				1	
Hirudinea	2	2	3	1	3
Gnathobdellida					
Pharyngobdellida	1	1	1	1	2
Rhynochobdellida	1	1	2		1
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda	1		1		1
Ostracoda					
Hydracarina			1		1
Collembola					
Tardigrada					
Ephemeroptera	5	4	5	3	4
Odonata	8	7	5	6	5
Plecoptera					
Hemiptera	3	4	2		1
Megaloptera		1	1		1
Neuroptera					
Trichoptera	14	8	9	4	9
Lepidoptera	1				
Coleoptera	1	3	1	1	
DIPTERA	32	26	38	26	39
Diptera Ceratopogonidae	3	4	5	1	3
Diptera Chironomidae	29	21	33	25	35
Sub-family Podonominae					
Sub-family Tanypodinae	5	4	6	4	6
Sub-family Diamesinae					
Sub-family Prodiamesinae	1		1		
Sub-family Orthocladiinae	4	3	4	3	7
Sub-family Chironominae	19	14	22	18	22
Tribe Chironomini	16	11	19	15	19
Tribe Tanytarsini	3	3	3	3	3
Diptera Tabanidae					
Diptera Tipulidae					
Diptera Chaoboridae		1			1
Diptera Misc.					
Gastropoda	1		2		1
Basomatophora	1		2		
Mesogastrophora					1
Pelecypoda	1	1	1		1
LAKE/YEAR	CR88	CR89	CR90	CR91	CR92
GENERA SUM	73	61	75	44	71

CRADLE

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda		2			
Dorylaimina					
Enoplida					
Mononchida		2			
Oligochaeta	21	7	7		3
Haplotaxida	2	3	1		1
Lumbriculida	19	4	3		2
Tubificida			3		
Hirudinea	5	7	7	1	6
Gnathobdellida					
Pharyngobdellida	4	5	4	1	2
Rhynochobdellida	1	2	3		4
Isopoda					
Amphipoda	1055	224	220	28	137
Decapoda	2		1		1
Ostracoda					
Hydracarina			2		1
Collembola					
Tardigrada					
Ephemeroptera	355	169	121	23	20
Odonata	26	59	26	16	18
Plecoptera					
Hemiptera	4	18	4		14
Megaloptera		1	1		1
Neuroptera					
Trichoptera	36	47	125	38	23
Lepidoptera	2				
Coleoptera	9	9	4	1	
DIPTERA	1646	682	3101	1025	1821
Diptera Ceratopogonidae	19	39	70	31	14
Diptera Chironomidae	1627	642	3031	994	1806
Sub-family Podonominae					
Sub-family Tanypodinae	222	74	484	212	529
Sub-family Diamesinae					
Sub-family Prodiamesinae	1		1		
Sub-family Orthocladiinae	140	110	54	87	158
Sub-family Chironominae	1264	458	2492	695	1119
Tribe Chironomini	882	346	1377	505	646
Tribe Tanytarsini	382	112	1115	190	473
Diptera Tabanidae					
Diptera Tipulidae					
Diptera Chaoboridae		1			1
Diptera Misc.					
Gastropoda	3		7		1
Basomatophora	3		7		
Mesogastrophora					1
Pelecypoda	26	12	19		7
LAKE/YEAR	CR88	CR89	CR90	CR91	CR92
ABUNDANCE SUM	3190	1237	3645	1132	2053

CROSSON

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					1
Nemertea					
Coelenterata					
Turbellaria	1	1			1
Nematoda	1	3	2	2	2
Dorylaimina		1	1		
Enoplida	1	1	1	1	1
Mononchida		1		1	1
Oligochaeta	4	9	2	3	3
Haplotaxida	2	7	1	1	1
Lumbriculida	1	1		1	1
Tubificida	1	1	1	1	1
Hirudinea	3	2	1	1	4
Gnathobdellida					
Pharyngobdellida	1		1	1	1
Rhynochobdellida	2	2			3
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda					
Ostracoda				2	
Hydracarina	1	5	2	4	4
Collembola		1			
Tardigrada					
Ephemeroptera	6	6	6	6	7
Odonata	12	8	11	10	13
Plecoptera					
Hemiptera	1	1		1	1
Megaloptera	2	1	1	1	
Neuroptera					
Trichoptera	10	14	11	13	19
Lepidoptera			1		
Coleoptera	3	5	4	5	5
DIPTERA	31	35	36	47	50
Diptera Ceratopogonidae	3	3	2	5	4
Diptera Chironomidae	28	30	32	39	45
Sub-family Podonominae	1				
Sub-family Tanypodinae	7	7	6	7	7
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	3	5	5	10	14
Sub-family Chironominae	17	18	21	22	24
Tribe Chironomini	14	13	17	18	21
Tribe Tanytarsini	3	5	4	4	3
Diptera Tabanidae		1	1		
Diptera Tipulidae	.	1			1
Diptera Chaoboridae				1	
Diptera Misc.			1	2	
Gastropoda	3	3	2	1	2
Basomatophora	2	2	1		
Mesogastrophora	1	1	1	1	2
Pelecypoda	1	1	1	1	2
LAKE/YEAR	CN88	CN89	CN90	CN91	CN92
GENERA SUM	82	97	82	97	118

CROSSON

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					2
Nemertea					
Coelenterata					
Turbellaria	1	4			3
Nematoda	2	15	2	2	2
Dorylaimina		1	1		
Enoplida	2	12	1	1	1
Mononchida		2		1	1
Oligochaeta	23	49	3	14	13
Haplotaxida	16	44	2	6	1
Lumbriculida	4	1		7	9
Tubificida	3	4	1	1	3
Hirudinea	8	2	2	1	11
Gnathobdellida					
Pharyngobdellida	3	2	2	1	4
Rhynochobdellida	5	2			7
Isopoda					
Amphipoda	1811	814	1995	1370	3019
Decapoda					
Ostracoda					8
Hydracarina	1	25	2	9	9
Collembola		3			
Tardigrada					
Ephemeroptera	805	762	405	907	1218
Odonata	324	148	370	176	237
Plecoptera					
Hemiptera	1	1		1	1
Megaloptera	7	6	3	2	
Neuroptera					
Trichoptera	142	103	240	141	528
Lepidoptera			4		
Coleoptera	112	328	184	187	67
DIPTERA	1627	3085	1491	1323	4040
Diptera Ceratopogonidae	35	60	6	85	101
Diptera Chironomidae	1592	3023	1483	1231	3938
Sub-family Podonominae	1				
Sub-family Tanypodinae	729	982	418	333	904
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	236	608	140	151	626
Sub-family Chironominae	626	1433 4	925	747	2408
Tribe Chironomini	351	666	790	571	1975
Tribe Tanytarsini	275	767	135	176	433
Diptera Tabanidae		1	1		
Diptera Tipulidae		1			1
Diptera Chaoboridae				4	
Diptera Misc.			1	3	
Gastropoda	47	65	45	4	4
Basomatophora	5	45	1		
Mesogastrophora	42	20	44	4	4
Pelecypoda	4	14	10	1	58
LAKE/YEAR	CN88	CN89	CN90	CN91	CN92
ABUNDANCE SUM	4915	5424	4756	4138	9220

DELANO

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata			1		
Turbellaria					
Nematoda	1	1		1	
Dorylaimina					
Enoplida	1		1		
Mononchida	1				
Oligochaeta	3	3	4	2	3
Haplotaxida	1	1	2		1
Lumbriculida	1	1	1	1	1
Tubificida	1	1	1	1	
Haemonais					1
Hirudinea	2	3	2	1	2
Gnathobdellida	1				
Pharyngobdellida		1	1	1	
Rhynochobdellida	1	2	1		2
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda					
Ostracoda				1	
Hydracarina		3	3	4	4
Collembola					
Tardigrada					
Ephemeroptera	5	5	6	6	4
Odonata	11	10	10	11	11
Plecoptera					
Hemiptera	1	2			
Megaloptera	1		1	1	
Neuroptera					
Trichoptera	11	12	10	14	16
Lepidoptera			1		
Coleoptera	3	8	5	4	2
DIPTERA	39	41	45	38	46
Diptera Ceratopogonidae	4	3	4	3	2
Diptera Chironomidae	35	36	38	33	42
Sub-family Podonominae					
Sub-family Tanypodinae	8	8	8	7	8
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	6	8	8	5	11
Sub-family Chironominae	21	20	22	21	23
Tribe Chironomini	18	17	18	17	19
Tribe Tanytarsini	3	3	4	4	4
Diptera Tabanidae		1	1	1	
Diptera Tipulidae		1	1		1
Diptera Chaoboridae					
Diptera Misc			1	1	1
Gastropoda	2	3	2	1	2
Basomatophora	2	2	1	1	1
Mesogastrophora		1	1		1
Pelecypoda	1	2	1	1	1
LAKE/YEAR	DO88	DO89	DO90	DO91	DO92
GENERA SUM	83	95	93	86	95

DELANO

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata			3		
Turbellaria					
Nematoda	1	3		1	
Dorylaimina					
Enoplida		3		1	
Mononchida	1				
Oligochaeta	8	47	11	4	6
Haplotaxida	2	15	2		1
Lumbriculida	4	2	2	3	4
Tubificida	2	30	7	1	
Haemonais					1
Hirudinea	3	18	3	1	2
Gnathobdellida	1				
Pharyngobdellida		1	2	1	
Rhynochobdellida	2	17	1		2
Isopoda					
Amphipoda	683	705	1421	745	840
Decapoda					
Ostracoda					1
Hydracarina		4	10	6	7
Collembola					
Tardigrada					
Ephemeroptera	768	858	309	210	194
Odonata	136	129	173	227	72
Plecoptera					
Hemiptera	1	3			
Megaloptera	1		2	1	
Neuroptera					
Trichoptera	38	132	53	83	81
Lepidoptera			1		
Coleoptera	18	175	267	209	70
DIPTERA	499	2450 1	1324	860	1721
Diptera Ceratopogonidae	14	141	28	20	21
Diptera Chironomidae	485	2304 1	1293	833	1696
Sub-family Podonominae					
Sub-family Tanypodinae	218	648	495	359	577
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	26	119	109	15	111
Sub-family Chironominae	241	1537 9	689	459	1008
Tribe Chironomini	175	1064	494	360	710
Tribe Tanytarsini	66	474	195	99	298
Diptera Tabanidae		2	1	2	
Diptera Tipulidae		3	1		3
Diptera Chaoboridae					
Diptera Misc			1	5	1
Gastropoda	2	184	53	2	7
Basomatophora	2	81	31	2	2
Mesogastrophora		103	22		5
Pelecypoda	31	49	14	10	4
LAKE/YEAR	DO88	DO89	DO90	DO91	DO92
ABUNDANCE SUM	2189	4757 1	3644	2359	3005

HAMER

LAKE/YEAR	1988	89	90	91	92
TAXONOMIC NAME					
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria	1				
Nematoda	1		1	1	
Dorylaimina					
Enoplida	1		1	1	
Mononchida					
Oligochaeta	6	2	3	7	4
Haplotaxida	4	1	1	4	1
Lumbriculida	1		1	1	2
Tubificida	1	1	1	2	1
Hirudinea	2	1	1	1	3
Gnathobdellida					
Pharyngobdellida	1		1		1
Rhynochobdellida	1	1		1	2
Isopoda					
Amphipoda	2	3	2	2	2
Decapoda					
Ostracoda			1		
Hydracarina	6	5	2	1	5
Collembola				1	
Tardigrada					
Ephemeroptera	5	4	5	3	4
Odonata	12	14	11	13	14
Plecoptera					
Hemiptera	2	2	3	1	
Megaloptera	1	1	1	1	1
Neuroptera		1	1	1	1
Trichoptera	10	12	11	13	14
Lepidoptera		1			1
Coleoptera	2	3	3	5	3
DIPTERA	37	38	43	54	48
Diptera Ceratopogonidae	3	5	5	5	5
Diptera Chironomidae	31	32	35	42	39
Sub-family Podonominae					
Sub-family Tanypodinae	6	6	8	9	9
Sub-family Diamesinae		1	1	1	
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	6	5	7	10	7
Sub-family Chironominae	19	20	19	22	23
Tribe Chironomini	16	17	17	19	20
Tribe Tanytarsini	3	3	2	3	3
Diptera Tabanidae	1	1	1	1	1
Diptera Tipulidae	1		2	6	2
Diptera Chaoboridae					1
Diptera Misc	1				
Gastropoda	1	2	1	2	1
Basomatophora	1	2	1	2	1
Mesogastrophora					
Pelecypoda	1	1	1	1	1
LAKE/YEAR	HR88	HR89	HR90	HR91	HR92
GENERA SUM	86	91	87	111	105

HAMER

LAKE/YEAR	1988	89	90	91	92
TAXONOMIC NAME					
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria	1				
Nematoda		1		1	1
Dorylaimina					
Enoplida		1		1	1
Mononchida					
Oligochaeta	64	13	8	18	21
Haplotaxida	36	4	1	6	5
Lumbriculida	18		5	7	15
Tubificida	10	9	2	54	1
Hirudinea	2	1	1	1	3
Gnathobdellida					
Pharyngobdellida	1		1		1
Rhynochobdellida	1	1		1	2
Isopoda					
Amphipoda	3617	1531	1589	724	1986
Decapoda					
Ostracoda				1	
Hydracarina	41	16	11	2	50
Collembola				2	
Tardigrada					
Ephemeroptera	1672	1552	1283	2489	991
Odonata	314	389	203	236	257
Plecoptera					
Hemiptera		22	51	13	1
Megaloptera	2	15	5	9	20
Neuroptera		1	1	1	2
Trichoptera	406	420	308	379	648
Lepidoptera		1			2
Coleoptera	4	17	13	15	5
DIPTERA	1521	2153	1326	2526	3260
Diptera Ceratopogonidae	389	472	290	202	206
Diptera Chironomidae	1129	1679	1023	2307	3045
Sub-family Podonominae					
Sub-family Tanypodinae	475	512	357	859	1006
Sub-family Diamesinae		5	1	4	
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	319	176	101	480	395
Sub-family Chironominae	335	986	564	964	1644
Tribe Chironomini	306	919	515	849	1497
Tribe Tanytarsini	29	67	49	115	147
Diptera Tabanidae	1	2	3	1	3
Diptera Tipulidae	1		10	16	5
Diptera Chaoboridae					1
Diptera Misc.	1				
Gastropoda	9	8	12	2	2
Basomatophora	9	8	12	2	2
Mesogastrophora					
Pelecypoda	270	82	132	75	491
LAKE/YEAR	HR88	HR89	HR90	HR91	HR92
ABUNDANCE SUM	7923	6222	4943	6494	7740

HARP

LAKE/YEAR	1988	89	90	91	92
Acanthocephala					
Nemertea			1	1	
Coelenterata		1			
Turbellaria	1	1	1	1	1
Nematoda	3	2	4	1	
Dorylaimina		1		1	
Enoplida	1	1	1	1	
Mononchida		1	1	2	
Oligochaeta	5	7	5	5	3
Haplotaxida	2	4	3	3	1
Lumbriculida	2	1	1	1	1
Tubificida	1	2	1	1	1
Hirudinea	2	1	1	1	2
Gnathobdellida					
Pharyngobdellida	1	1	1		1
Rhynochobdellida	1			1	1
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda					
Ostracoda			1	2	
Hydracarina		5	4	4	5
Collembola					
Tardigrada				1	
Ephemeroptera	6	5	6	7	6
Odonata	9	8	8	7	8
Plecoptera	1				
Hemiptera	1		1	2	1
Megaloptera	1		1	1	1
Neuroptera					
Trichoptera	10	13	9	9	13
Lepidoptera	1	1	1		
Coleoptera	4	3	4	3	3
DIPTERA	34	44	31	44	43
Diptera Ceratopogonidae	5	5	4	4	5
Diptera Chironomidae	28	38	26	39	38
Sub-family Podonominae					
Sub-family Tanypodinae	7	7	5	9	8
Sub-family Diamesinae					
Sub-family Prodiamesinae	1	1	1	1	1
Sub-family Orthocladiinae	4	7	3	8	9
Sub-family Chironominae	16	23	17	21	20
Tribe Chironomini	13	18	13	16	15
Tribe Tanytarsini	3	5	4	5	5
Diptera Tabanidae		1			
Diptera Tipulidae	1				
Diptera Chaoboridae					
Diptera Misc.			1	1	
Gastropoda	4	3	5	3	3
Basomatophora	3	1	3	1	2
Mesogastrophora	1	2	2	1	1
Pelecypoda	2	1	1	1	2
LAKE/YEAR	HP88	HP89	HP90	HP91	HP92
GENERA SUM	83	98	82	97	99

HARP

LAKE/YEAR	1988	89	90	91	92
Acanthocephala					
Nemertea				8	8
Coelenterata		1			
Turbellaria	27	16	6	5	6
Nematoda		13	9	28	1
Dorylaimina		2		7	
Enoplida		3	4	9	1
Mononchida		8	5	12	
Oligochaeta	61	42	56	28	16
Haplotaxida	26	20	27	25	4
Lumbriculida	25	11	13	2	9
Tubificida	10	11	16	1	3
Hirudinea	3	1	3	1	8
Gnathobdellida					
Pharyngobdellida	2	1	3		3
Rhynochobdellida	1			1	5
Isopoda					
Amphipoda	2095	817	1335	571	1585
Decapoda					
Ostracoda				3	9
Hydracarina		10	13	23	44
Collembola					
Tardigrada				16	
Ephemeroptera	324	147	306	121	158
Odonata	346	122	265	205	160
Plecoptera	1				
Hemiptera	1		2	7	2
Megaloptera	3		5	3	2
Neuroptera					
Trichoptera	77	57	63	71	76
Lepidoptera	4	2	1		
Coleoptera	29	85	113	81	59
DIPTERA	1043	1180	1081	1678	814
Diptera Ceratopogonidae	59	107	52	177	24
Diptera Chironomidae	983	1071	1028	1498	790
Sub-family Podonominae					
Sub-family Tanypodinae	456	230	421	608	417
Sub-family Diamesinae					
Sub-family Prodiamesinae	24	29	6	5	6
Sub-family Orthocladiinae	69	129	38	316	106
Sub-family Chironominae	434	683	563	569	261
Tribe Chironomini	292	441	358	317	186
Tribe Tanytarsini	142	242	205	252	75
Diptera Tabanidae		2			
Diptera Tipulidae	1				
Diptera Chaoboridae					
Diptera Misc			1	3	
Gastropoda	92	231	163	142	69
Basomatophora	8	3	8	5	23
Mesogastrophora	84	228	155	137	46
Pelecypoda	227	97	84	17	70
LAKE/YEAR	HP88	HP89	HP90	HP91	HP92
ABUNDANCE SUM	4333	2821	3505	3008	3087

PINCHER LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda	2		1	2	1
Dorylaimina					
Enoplida	1		1	1	1
Mononchida	1			1	
Oligochaeta	4	2	3	4	3
Haplotaxida	2	1	2	2	2
Lumbriculida	1	1	1	1	1
Tubificida	1			1	
Hirudinea	2	2	2	1	3
Gnathobdellida					
Pharyngobdellida	1	1	2		1
Rhynochobdellida	1	1		1	2
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda					
Ostracoda					
Hydracarina				2	
Collembola				1	
Tardigrada					
Ephemeroptera	2	2	2	2	2
Odonata	6	8	7	9	7
Plecoptera					
Hemiptera	3	4	3	2	3
Megaloptera	1			1	
Neuroptera					
Trichoptera	8	13	11	9	13
Lepidoptera		1			
Coleoptera	2	6	1	2	1
DIPTERA	27	29	27	43	34
Diptera Ceratopogonidae	3	2	1	3	2
Diptera Chironomidae	23	25	25	37	31
Sub-family Podonominae					
Sub-family Tanypodinae	5	4	5	7	5
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	3	4	3	6	6
Sub-family Chironominae	15	17	17	24	20
Tribe Chironomini	12	14	15	20	17
Tribe Tanytarsini	3	3	2	4	3
Diptera Tabanidae	1	1	1	1	
Diptera Tipulidae					
Diptera Chaoboridae				1	1
Diptera Misc		1		1	
Gastropoda	1	1	1	1	1
Basomatophora	2	1	1		1
Mesogastrophora				1	
Pelecypoda	1	1	1	1	1
LAKE/YEAR	PN88	PN89	PN90	PN91	PN92
GENERA SUM	62	71	62	83	72

PINCHER LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda	3		1	19	1
Dorylaimina					
Enoplida	1		1	6	1
Mononchida	2			13	
Oligochaeta	27	7	4	12	39
Haplotaxida	5	1	2	7	3
Lumbriculida	21	6	2	4	36
Tubificida	1			1	
Hirudinea	4	11	4	1	12
Gnathobdellida					
Pharyngobdellida	3	9	4		6
Rhynochobdellida	1	2		1	6
Isopoda					
Amphipoda	448	733	367	155	612
Decapoda					
Ostracoda					
Hydracarina				4	
Collembola				1	
Tardigrada					
Ephemeroptera	451	930	420	357	388
Odonata	31	546	101	398	115
Plecoptera					
Hemiptera	6	93	11	6	18
Megaloptera	1			1	
Neuroptera					
Trichoptera	71	608	170	175	279
Lepidoptera		1			
Coleoptera	8	29	6	2	1
DIPTERA	1652	5644 7	1952	5707	4633
Diptera Ceratopogonidae	57	275	48	252	102
Diptera Chironomidae	1594	5364 7	1902	5451	4527
Sub-family Podonominae					
Sub-family Tanypodinae	445	694 8	341	1700	1227
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	217	1183.1	226	605	431
Sub-family Chironominae	932	3486.8	1335	3146	2869
Tribe Chironomini	698	2341	1135	2319	2106
Tribe Tanytarsini	234	1145.8	200	827	763
Diptera Tabanidae	1	4	2	1	
Diptera Tipulidae					
Diptera Chaoboridae				2	4
Diptera Misc.		1		1	
Gastropoda	2	4	2	1	1
Basomatophora	2	4	2		1
Mesogastrophora				1	
Pelecypoda	115	121	49	76	251
LAKE/YEAR	PN88	PN89	PN90	PN91	PN92
ABUNDANCE SUM	2819	8727 7	3087	6915	6350

PLASTIC LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria		1	1		
Nematoda	1	2	1	2	
Dorylaimina					
Enoplida	1	1		1	
Mononchida		1	1	1	
Oligochaeta	6	3	3	4	3
Haplotaxida	3	1	1	1	1
Lumbriculida	2	1	1	1	1
Tubificida	1	1	1	2	1
Hirudinea	3	1	1	1	2
Gnathobdellida					
Pharyngobdellida					
Rhynochobdellida	3	1	1	1	2
Isopoda					
Amphipoda	2	1	2	2	2
Decapoda					
Ostracoda					
Hydracarina	2			1	3
Collembola					
Tardigrada					
Ephemeroptera	3	2	2	3	2
Odonata	10	7	7	11	10
Plecoptera					
Hemiptera		2	2		
Megaloptera					
Neuroptera					
Trichoptera	11	10	12	10	12
Lepidoptera	1		1	1	
Coleoptera	1		1	1	
DIPTERA	34	33	35	41	41
Diptera Ceratopogonidae	3	3	2	5	4
Diptera Chironomidae	28	30	30	34	34
Sub-family Podonominae					
Sub-family Tanypodinae	5	6	5	6	7
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	5	5	5	7	5
Sub-family Chironominae	18	19	20	21	22
Tribe Chironomini	15	16	16	17	19
Tribe Tanytarsini	3	3	4	4	3
Diptera Tabanidae					1
Diptera Tipulidae	2		1	2	1
Diptera Chaoboridae	1		1		
Diptera Misc.			1		1
Gastropoda	1	2	1		1
Basomatophora	1	2	1		1
Mesogastrophora					
Pelecypoda	1	1	1	1	1
LAKE/YEAR	PC88	PC89	PC90	PC91	PC92
GENERA SUM	77	63	70	80	78

PLASTIC LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria		2	1		
Nematoda	1	3	1	4	
Dorylaimina					
Enoplida	1	1		2	
Mononchida		2	1	2	
Oligochaeta	28	21	9	19	17
Haplotaxida	10	10	1	1	5
Lumbriculida	17	9	5	14	8
Tubificida	1	2	3	4	4
Hirudinea	8	1	1	1	5
Gnathobdellida					
Pharyngobdellida					
Rhynochobdellida	8	1	1	1	5
Isopoda					
Amphipoda	343	106	348	381	612
Decapoda					
Ostracoda					
Hydracarina	2			1	4
Collembola					
Tardigrada					
Ephemeroptera	263	49	32	102	222
Odonata	118	38	58	138	66
Plecoptera					
Hemiptera			2	3	
Megaloptera					
Neuroptera					
Trichoptera	113	39	88	127	260
Lepidoptera	1		2	3	
Coleoptera	1		1	1	
DIPTERA	2224	1544	1192	1666	1974
Diptera Ceratopogonidae	70	79	110	247	177
Diptera Chironomidae	2150	1465	1073	1408	1791
Sub-family Podonominae					
Sub-family Tanypodinae	482	358	185	442	451
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	381	353	188	148	307
Sub-family Chironominae	1287	754	700	818	1033
Tribe Chironomini	885	495	500	660	793
Tribe Tanytarsini	402	259	200	158	240
Diptera Tabanidae					1
Diptera Tipulidae	3		7	11	4
Diptera Chaoboridae	1		1		
Diptera Misc			1		1
Gastropoda	10	11	2		2
Basomatophora	10	11	2		2
Mesogastrophora					
Pelecypoda	193	192	76	19	91
LAKE/YEAR	PC88	PC89	PC90	PC91	PC92
ABUNDANCE SUM	3305	2006	1813	2465	3253

SKIDWAY

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda		1			
Dorylaimina					
Enoplida		1			
Mononchida					
Oligochaeta	3	2	1	6	3
Haplotaxida	1	1		3	2
Lumbriculida	2	1	1	2	1
Tubificida				1	
Hirudinea		1	2	1	4
Gnathobdellida			1		
Pharyngobdellida		1	1	1	2
Rhynochobdellida					2
Isopoda	1	1	1		
Amphipoda	2	2	2	2	2
Decapoda					
Ostracoda					
Hydracarina	2		1	2	1
Collembola					
Tardigrada					
Ephemeroptera	4	3	3	3	3
Odonata	11	8	11	10	10
Plecoptera					
Hemiptera	4	2	2	1	3
Megaloptera	2	1	1	1	1
Neuroptera					
Trichoptera	13	10	10	13	11
Lepidoptera	1			1	
Coleoptera	5	2	1	2	1
DIPTERA	42	26	31	32	38
Diptera Ceratopogonidae	3	3	2	3	5
Diptera Chironomidae	36	22	29	28	32
Sub-family Podonominae					
Sub-family Tanypodinae	7	6	6	6	8
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	7	2	4	3	6
Sub-family Chironominae	22	14	19	19	18
Tribe Chironomini	19	11	16	17	15
Tribe Tanytarsini	3	3	3	2	3
Diptera Tabanidae	1	1			
Diptera Tipulidae	1				1
Diptera Chaoboridae				1	
Diptera Misc	1				
Gastropoda					1
Basomatophora					1
Mesogastrophora					
Pelecypoda	1	1	1	1	1
LAKE/YEAR	SY88	SY89	SY90	SY91	SY92
GENERA SUM	91	60	67	77	81

SKIDWAY

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria					
Nematoda		1			
Dorylaimina					
Enoplida		1			
Mononchida					
Oligochaeta	8	3	4	25	25
Haplotaxida	3	1		9	7
Lumbriculida	5	2	4	14	18
Tubificida				2	
Hirudinea		1	3	4	11
Gnathobdellida			1		
Pharyngobdellida		1	2	4	8
Rhynochobdellida					3
Isopoda	115	24	8		
Amphipoda	311	109	100	27	83
Decapoda					
Ostracoda					
Hydracarina	5		1	3	6
Collembola					
Tardigrada					
Ephemeroptera	1582	444	955	505	447
Odonata	264	179	138	139	72
Plecoptera					
Hemiptera	26	5	2	2	4
Megaloptera	12	2	4	26	16
Neuroptera					
Trichoptera	496	156	203	241	266
Lepidoptera	4			1	
Coleoptera	27	2	1	4	1
DIPTERA	6040	4451 4	3176	2944	5821
Diptera Ceratopogonidae	414	269	168	248	222
Diptera Chironomidae	5620	4181 4	3008	2689	5598
Sub-family Podonominae					
Sub-family Tanypodinae	956	630	528	1227	1725
Sub-family Diamesinae					
Sub-family Prodiamesinae					
Sub-family Orthocladiinae	575	398	121	245	223
Sub-family Chironominae	4089	3153.2	2359	1217	3650
Tribe Chironomini	3822	2705	2228	1014	3036
Tribe Tanytarsini	267	448	131	203	614
Diptera Tabanidae	1	1			
Diptera Tipulidae	3				1
Diptera Chaoboridae				7	
Diptera Misc.	2				
Gastropoda					2
Basomatophora					2
Mesogastrophora					
Pelecypoda	6	58	2	71	54
LAKE/YEAR	SY88	SY89	SY90	SY91	SY92
ABUNDANCE SUM	8896	5435 4	4597	3992	6808

WESTWARD					
LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria	1	1	1		
Nematoda	1	2	1	2	2
Dorylaimina					1
Enoplida		1		1	
Mononchida	1	1	1	1	1
Oligochaeta	6	8	5	5	6
Haplotaxida	4	5	3	2	3
Lumbriculida	2	2	1	2	2
Tubificida		1	1	1	1
Hirudinea	6	1	2	3	2
Gnathobdellida	1				
Pharyngobdellida	2	1	1	1	1
Rhynochobdellida	3		1	2	1
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda		1			1
Ostracoda					
Hydracarina			1		
Collembola					
Tardigrada					
Ephemeroptera	5	5	3	5	4
Odonata	4	4	5	5	5
Plecoptera	1				
Hemiptera	2	1		1	2
Megaloptera	1	1	1	1	1
Neuroptera					
Trichoptera	8	11	10	6	9
Lepidoptera	1	1	1	1	
Coleoptera	4	3	3	2	2
DIPTERA	46	40	41	37	49
Diptera Ceratopogonidae	6	4	3	3	5
Diptera Chironomidae	37	36	37	33	40
Sub-family Podonominae					
Sub-family Tanypodinae	7	6	7	5	8
Sub-family Diamesinae					
Sub-family Prodiamesinae	1	1	1	1	1
Sub-family Orthocladiinae	8	9	8	6	11
Sub-family Chironominae	21	20	21	21	20
Tribe Chironomini	16	15	16	16	16
Tribe Tanytarsini	5	5	5	5	4
Diptera Tabanidae					
Diptera Tipulidae					2
Diptera Chaoboridae					1
Diptera Misc	3		1	1	1
Gastropoda	2	2	2	1	1
Basomatophora	1	1	1		1
Mesogastrophora	1	1	1	1	
Pelecypoda	1	1	1	1	1
LAKE/YEAR	WD88	WD89	WD90	WD91	WD92
GENERA SUM	91	84	79	72	88

WESTWARD					
LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea					
Coelenterata					
Turbellaria	8	51	6		
Nematoda	2	47	25	13	4
Dorylaimina					1
Enoplida		1		2	
Mononchida	2	46	25	11	3
Oligochaeta	89	216	483	191	53
Haplotaxida	41	190	432	159	38
Lumbriculida	48	19	45	12	12
Tubificida		7	6	20	3
Hirudinea	16	1	8	18	3
Gnathobdellida	1				
Pharyngobdellida	4	1	2	2	1
Rhynochobdellida	11		6	16	2
Isopoda					
Amphipoda	1312	620	1161	894	601
Decapoda		1			1
Ostracoda					
Hydracarina			1		
Collembola					
Tardigrada					
Ephemeroptera	417	774	684	104	209
Odonata	31	19	11	32	19
Plecoptera	2				
Hemiptera	7	6		2	2
Megaloptera	1	7	4	2	2
Neuroptera					
Trichoptera	38	41	119	26	83
Lepidoptera	3	12	7	8	
Coleoptera	25	83	48	43	32
DIPTERA	1155	3728 2	5104	4733	1478
Diptera Ceratopogonidae	124	421	1103	2355	50
Diptera Chironomidae	1024	3307 2	3998	2348	1422
Sub-family Podonominae					
Sub-family Tanypodinae	262	191	497	252	350
Sub-family Diamesinae					
Sub-family Prodiamesinae	5	4	7	14	9
Sub-family Orthocladiinae	41	113	118	73	169
Sub-family Chironominae	716	2999 2	3376	2009	894
Tribe Chironomini	376	1564	1222	745	519
Tribe Tanytarsini	340	1435	2154	1264	375
Diptera Tabanidae					
Diptera Tipulidae					2
Diptera Chaoboridae					1
Diptera Misc.	7		3	30	3
Gastropoda	5	16	64	55	5
Basomatophora	3	6	33		5
Mesogastrophora	2	10	31	55	
Pelecypoda	217	566	1026	1177	108
LAKE/YEAR	WD88	WD89	WD90	WD91	WD92
ABUNDANCE SUM	3328	6188 2	8751	7298	2600

YOUNG

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea				1	1
Coelenterata					
Turbellaria		1	1	1	1
Nematoda	2	2	1	2	1
Dorylaimina					
Enoplida	1	1	1	1	1
Mononchida	1	1		1	
Oligochaeta	5	4	4	4	6
Haplotaxida	2	2	1	2	3
Lumbriculida	2	2	2	1	2
Tubificida	1		1	1	1
Hirudinea	4	2	2		2
Gnathobdellida					
Pharyngobdellida	1	1	1		
Rhynochobdellida	3	1	1		2
Isopoda					
Amphipoda	2	2	2	2	2
Decapoda	1	1	1	1	
Ostracoda					
Hydracarina	1	1		2	2
Collembola					
Tardigrada					
Ephemeroptera	7	8	5	7	5
Odonata	7	6	5	6	8
Plecoptera	1			2	
Hemiptera					
Megaloptera	1	1	1		1
Neuroptera					
Trichoptera	9	12	8	13	12
Lepidoptera	1	1	1	1	
Coleoptera	5	8	5	7	4
DIPTERA	35	34	33	50	41
Diptera Ceratopogonidae	3	3	4	5	3
Diptera Chironomidae	30	29	28	43	36
Sub-family Podonominae					
Sub-family Tanypodinae	6	7	7	8	8
Sub-family Diamesinae	1	1		1	1
Sub-family Prodiamesinae	1		1	2	2
Sub-family Orthocladinae	4	4	3	11	7
Sub-family Chironominae	18	17	17	21	18
Tribe Chironomini	14	13	13	16	14
Tribe Tanytarsini	4	4	4	5	4
Diptera Tabanidae	1				
Diptera Tipulidae	1	1		1	2
Diptera Chaoboridae				1	
Diptera Misc		1	1		
Gastropoda	5	6	4	5	4
Basomatophora	3	4	2	3	2
Mesogastrophora	2	2	2	2	2
Pelecypoda	1	1	1	1	1
LAKE/YEAR	YG88	YG89	YG90	YG91	YG92
GENERA SUM	87	90	74	107	92

YOUNG

LAKE/YEAR TAXONOMIC NAME	1988	89	90	91	92
Acanthocephala					
Nemertea				16	32
Coelenterata					
Turbellaria		17	10	2	8
Nematoda	4	10	1	2	1
Dorylaimina					
Enoplida	2	3	1	1	1
Mononchida	2	7		1	
Oligochaeta	23	145	52	154	53
Haplotaxida	10	116	14	66	5
Lumbriculida	10	29	8	79	41
Tubificida	3		30	9	7
Hirudinea	9	4	5		3
Gnathobdellida					
Pharyngobdellida	3	3	3		
Rhynochobdellida	6	1	2		3
Isopoda					
Amphipoda	1980	3434	970	2192	2870
Decapoda	1	1	1	1	
Ostracoda					
Hydracarina	1	1		3	2
Collembola					
Tardigrada					
Ephemeroptera	118	270	38	265	82
Odonata	67	200	85	168	93
Plecoptera	1			5	
Hemiptera					
Megaloptera	1	3	4		2
Neuroptera					
Trichoptera	52	128	70	197	81
Lepidoptera	2	7	45	10	
Coleoptera	11	242	133	146	49
DIPTERA	649	2646.5	1014	1072	449
Diptera Ceratopogonidae	21	104	158	82	33
Diptera Chironomidae	625	2540.5	855	987	414
Sub-family Podonominae					
Sub-family Tanypodinae	327	867	197	174	150
Sub-family Diamesinae	3	1		1	1
Sub-family Prodiamesinae	3		1	5	2
Sub-family Orthocladinae	5	185	8	161	39
Sub-family Chironominae	287	1487.9	649	646	222
Tribe Chironomini	231	522	314	291	132
Tribe Tanytarsini	56	966	335	355	90
Diptera Tabanidae	1				
Diptera Tipulidae	2	1		1	2
Diptera Chaoboridae				2	
Diptera Misc		1	1		
Gastropoda	96	156	97	187	151
Basomatophora	22	24	7	16	5
Mesogastrophora	74	132	90	171	146
Pelecypoda	231	56	17	325	402
LAKE/YEAR	YG88	YG89	YG90	YG91	YG92
ABUNDANCE SUM	3246	7320.5	2542	4745	4278

APPENDIX 8

TAXONOMIC REFERENCES
USED IN THE IDENTIFICATION OF THE BENTHIC INVERTEBRATES

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